Information Technology Systems 1

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Getting to know your unit

Assessment

You will be externally assessed by means of a 2 hour test.

Information technology (IT) systems are involved in almost everything we do in society and have a significant role in our way of life. IT systems have benefited our society in many ways such as communication, finance, medicine and farming. Having a good understanding of how to effectively select and use appropriate IT systems for both personal and business use will put you in a strong position when considering higher education or getting a job in the IT industry.

You will be learning about hardware and software and how they come together and interact with each other to form an IT system. You will also be learning about the relationship between users and systems and the decisions that businesses and individuals need to make. You will be exploring issues related to using IT systems and their impact on us as individuals and also how they affect business practices.

In this unit, you will draw on your learning from across your programme to complete assessment tasks set by your teacher.

This unit will give you a fundamental and synoptic understanding of all areas of IT, which will support progression to an IT-related higher education course.

How you will be assessed

This unit is externally assessed by means of a written examination, which will last for two hours. You will be assessed on your understanding of computer systems and the implications of their use in personal and professional situations.

Grade descriptors

To achieve a grade, you will be expected to demonstrate the following attributes across the essential content of the unit. The maximum number of marks for this unit is 90.

To pass this unit:

- you will be able to apply knowledge and understanding of key information technology concepts to a range of familiar vocational contexts
- you will apply knowledge and understanding of IT systems to deconstruct problems in common situations and apply standard IT conventions to produce solutions with supporting reasoning
- you will be able to identify the impact of effective and ineffective uses of IT systems and recommend ways in which IT can be developed and/or improved
- you will explore and make judgements on the impact of the use of IT on individuals and organisations.

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To achieve a distinction:

- you will be able to analyse complex information, data and situations, in vocational contexts, in order to draw conclusions and make valid observations
- you will be able to synthesise your knowledge and understanding of IT systems to deconstruct complex problems, drawing on various sources of information to develop effective solutions
- you will evaluate the effectiveness of IT systems and make justified recommendations for further developments and future actions
- you will make valid, justified judgements on the impact of IT on individuals, organisations and wider society.

Assessment outcomes

AO1 Demonstrate knowledge and understanding of information technology terms, standards, concepts and processes.

Command words: identify, give, state, name, complete, draw.

Marks: ranges from 1 to 6 marks.

AO2 Apply knowledge and understanding of information technology terms, standards, concepts and processes.

Command words: complete, draw, describe, explain, calculate, produce, demonstrate.

Marks: ranges from 1 to 10 marks.

AO3 Select and use information technologies and procedures to explore likely outcomes and find solutions to problems in context.

Command words: explain, calculate, produce, develop, demonstrate.

Marks: ranges from 1 to 6 marks.

AO4 Analyse and evaluate information, technologies and procedures in order to recommend and justify solutions to IT problems.

Command words: discuss, demonstrate, analyse, produce, write.

Marks: ranges from 6 to 12 marks.

AO5 Make connections between the application of technologies, procedures, outcomes and solutions to resolve IT problems.

Command words: write, produce, evaluate.

Marks: ranges from 6 to 12 marks.

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Getting started

Information technology impacts on our lives on a daily basis. We rely on computers to perform even basic tasks such as telling the time.
List any devices that you use. Add those that you are aware of but have never used. Update the list as you learn about other types of technology.

A Digital devices in IT systems

This section introduces you to the concepts and implications of the use of the devices that form IT systems and the relationships between them. You are already familiar with a variety of IT systems and have probably come to rely on them in your everyday life. It must be hard to imagine that you are part of possibly the first generation to grow up with IT systems from birth.

Here are some of the digital devices, their functions and uses, some of which you may not have used before or maybe not even heard about.

Digital devices, their functions and use

Although IT devices are becoming more sophisticated at a rapid pace, businesses have been reliant on multiple digital technologies to manage their practices for quite a long time. Many of us are unaware that computers are relied upon for the functioning of familiar everyday items, such as:

- ovens
- washing machines
- tractors
- motor cycles
- medical equipment
- lighting.
- watches
- cars
- hearing aids
- aircraft
- heating systems

You are going to consider in more detail those more sophisticated digital devices that we rely on to form IT systems in our personal lives and those affecting businesses. You will look at the features and uses of digital devices in IT systems to meet the needs of individuals and organisations

Digital devices that form part or all of IT systems

There are a number of digital devices that go to make up standard IT systems for both personal and business use.

Multifunctional devices

Multifunctional devices (**MFDs**) are also known as **AIOs**. MFDs perform several different purposes. They include printers which not only print, but also scan, photocopy, fax and email.

Key terms

AIO – an all-in-one (AIO) device is one which is multifunctional. They are also known as MFDs.

MFD – a multifunctional device, such as a smartphone, a camera which connects to the internet or a printer which also scans and photocopies. They are also known as AIOs.

Standalone computer – a computer not reliant on any other computers or digital devices to function; therefore it can be used independently.

Personal computers

Personal computers (PCs) are those which are general purpose and available in a range of sizes, levels of power and capacity, and which are affordable to many for personal use. They operate as **standalone computers** and are very often lightweight and portable. (Personal computers includes laptops and netbooks as well as static tower PCs.)

PCs first came onto the market in the late 1970s when 'micro-computers' were launched to the market. Until that time, computers were large pieces of equipment, often filling entire rooms dedicated solely for computer systems.

PCs combine multiple digital functions, as well being able to store large amounts of data produced in spreadsheets and word-processed documents. They also provide storage and manipulation for images, music and videos. It is standard for PCs to have:

- access to the internet
- sound and other media software
- integrated microphones and webcams for communicating visually as well verbally.

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PCs execute software, such as the widely used Microsoft® Office® suite, so that it can be employed by the user, and can connect to other digital devices, making it possible to share files across all of your personal devices (for example smartphone, tablet or camera).

Mainframe computers

There are still some circumstances in which computers fill large amounts of space. These are known as mainframe computers and they are used for processing enormous amounts of data, which even the most powerful of standalone computers are unable to do.

Large mainframe computers are used by very large organisations, such as Amazon, eBay, IBM and some major airlines. Some government agencies also rely on mainframe computers where large amounts of data are processed. Mainframe computers are not the same as servers. Servers are powerful computers that provide network services such as network applications, storage and other resources for users on the same and other computers.

Research

Search online for businesses that use large mainframe computers. Make a list and try to identify what they use them for.

Mobile devices

Mobile device is a term given to any digital device which can be carried around easily and which is usually WiFi enabled. They typically weigh less than a bag of sugar and can fit into a pocket or bag comfortably. Examples of manufacturers of mobile devices include:

- Motorola
- Apple
- LG
- Huawei
- Microsoft
- Samsung.

Mobile devices such as these have become a must-have personal item, enabling us to keep in touch while on the move. Since the introduction of smartphones for general sale from IBM in 1994, we have had a world full of information at our fingertips. With the introduction of smartphones came touchscreens and the ability to access email and the internet on our phones. As you can imagine, flagship models displaying the latest technology are quite expensive.

Early smartphones were ahead of their time as we did not have the wireless infrastructure that we have today. You might liken this to the invention of the telephone by Alexander Graham Bell; he had a phone but who could he call? When smartphones were first invented the internet was a much smaller place and far fewer people had the internet at home or owned smartphones.

Servers

Servers provide services for other computers on the network. The network could comprise a series of cables which connect the server to other computers, perhaps in a small office, or could provide virtual connections via the internet. Your place of study will probably operate in the same way. All the computers are networked together using network infrastructure. A server then manages the logical access to the resources.

Servers are used not only to store data files centrally so that several people can access them, but also to store software centrally to relieve storage space on individual PCs. As all the data is stored centrally, it can be backed up from one location. Servers also allow shared access to devices such as printers and scanners. They authenticate users and perform account management for users.

You may have heard of, or use the cloud. The cloud is a term used to mean servers that are geographically separate from the user. These servers often offer some sort of storage service.

Link

We shall look at some options for cloud servers in the section Online systems.

Entertainment systems

Entertainment systems are multifunctional, comprising sound and vision. They manage music and video files, which contain large amounts of data and can quickly reduce the available capacity of a PC or mobile device. Entertainment systems can be operated from a central server, known as a digital media server. Central servers for home use have recently become much more readily affordable and simple to use.

Entertainment systems often combine the facility to record, and many provide facilities for editing and mixing digital (music or video) files. Many connect to the internet and interact with other peripheral devices. The most familiar of these systems, which are considerably variable in size and price include:

- MP3 and MP4 players
- home video theatre
- in-car entertainment systems
- Apple TV
- NOW TV
- music centres
- DAB radios
- Amazon Fire TV
- Google Chromecast
- Roku.

Link

For more about peripheral devices see Peripheral devices and media.

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Key term

DAB – digital audio broadcasting, which converts audio broadcasts to digital signal to reduce atmospheric and other interference.

Smart TVs can be defined as entertainment systems, in addition to PCs, tablets and many other digital devices. The digital world now makes it possible to have devices and systems which provide a wide range of entertainment options, which not so long ago would have required multiple devices.

Research

Research how the digital revolution began and what led to the creation of the worldwide web.

Begin your search in the mid-1900s.

You can extend your search to the developments which have arisen through space travel, by searching https://www.nasa.gov/.

Larger entertainment systems include those you might have seen at concerts, the theatre or in clubs or bars.

Digital cameras

Digital cameras capture two different types of images.

- Still – images that do not move (photos). They occupy much less storage space than moving images.
- Video – moving images which comprise a series of frames to make a film. Videos include sound and can be edited to include subtitles. It is also possible to capture single frames from a video as a still image.

Digital cameras encode digital images by breaking a picture into tiny squares called pixels and store the images onto a memory card. The resolution of the image captured is a count of how many pixels are used to make up the image. A high resolution image may contain several million pixels (1 million pixels = 1 megapixel). A modern digital camera is between 10 and 20 megapixels. Several digital devices have camera functions, for example smartphones and tablets, and can store photos on the hard drive or an SD card.

SLR cameras are becoming increasingly popular again with the development of digital SLRs. Digital SLRs (DSLRs) are especially popular for specialist photography, because of the high quality of the images produced, depending on the quality of the camera lens.

Key terms

SLR camera – a single lens reflex (SLR) camera uses a lens which captures the scope of the image you actually see. They are a type of camera used by keen amateur and professional photographers. Digital SLR cameras are known as DSLR cameras. They have a much larger, better-quality sensor, capturing a better image than traditional cameras.

Special-effect lenses and interchangeable lenses can be bought for DSLR cameras, for example:

- wide angle
- fish-eye
- macro (for close-up photos)
- multi-faceted (for star-burst effects)
- zoom (for long distance photos).

Navigation systems

Navigation systems are those which use **GPS** or GPS working alongside Global Navigation Satellite System (GLONASS) to navigate to locations. In addition, they can provide information about:

- traffic congestion
- road works
- accidents
- weather
- points of interest.

Key term

GPS – the global positioning system (GPS) is an accurate worldwide navigational and surveying facility. It uses the signals from orbiting satellites to work out the position of the device.

Navigation systems can be standalone, such as TomTom or Garmin products. These products are portable and can be ftted into vehicles to enable the driver to navigate. Many vehicles now come with factory-fitted GPS, either as standard or as an extra. Some motorbikes also come fitted with navigation systems.

You may have a navigation system integrated in your smartphone which enables you to find your way around while driving, cycling or walking.

Data capture and collection systems

Data capture and collection systems, also known as electronic data capture (EDC), are those which take information and collect it to perform a specific task. Examples are:

- credit and debit card readers for payment transactions

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- iris and fingerprint recognition systems for biometric entry and authentication systems
- medical scanning machines such as magnetic resonance imaging (MRI), dual-energy X-ray absorptiometry (DEXA) and computed tomography (CT) scanners
- radio-frequency identification (RFID) used in stock control, race timing systems
- personal digital assistants (PDAs) with integrated barcode scanners for stock control
- automatic number plate recognition (ANPR) cameras for crime prevention and enforcement
- barcode readers for fast data entry such as at checkouts and for courier services.

A data capture system

Data capture and collection systems are reported to be used frequently in clinical trials to gather data for analysis.

Link

For more about iris and fingerprint recognition systems, see http://findbiometrics.com/solutions/iris-scanners-recognition/.

For more about data capture and collection systems used in clinical trials, visit http://www.bioclinica.com/ and http://journal.frontiersin.org/researchtopic/363/electronic-data-capture-representation-and-applications-in-neuroimaging.

Communication devices and systems

With such a diverse mix of systems and devices in information systems today, communication is essential. Communication devices and systems allow digital devices to communicate with each other, whether in the same room or on the other side of the world. The growing demands of digital devices to interact with each other and the cloud has resulted in the resilient global communications we see today. Some of the devices and systems used for communication are.

- Satellites – these operate without cables by using satellite dishes as a two-way method of transmitting data (This is an option for remote areas where broadband is not available.)
- WiFi (IEEE 802.11 wireless) – connects devices without wires using high frequency radio waves.
- FTTC (fibre to the cabinet) – fibre-optic **broadband** offers speedier broadband connections than copper cabling alone. With FTTC, the customer's local cabinet has fibre and the last section of the connection to the premises is traditional copper.
- FTTP (fibre to the premises) – fibre-optic broadband offers even speedier broadband connections than FTTC.
- 4G/LTE – these are high-speed mobile data networks offering connectivity while on the move at speeds up to 50Mbps.
- Bluetooth – this is often used for personal area networks (PANs) to connect peripherals such as headsets, mice, keyboards and bar code scanners to PCs and mobile devices.

Link

Bluetooth is another method for transferring information between devices and is discussed in more detail later in the unit.

Key terms

Broadband – a high-speed transmission technique, whereby a wide band of frequencies are used to transmit messages. It commonly refers to internet access via a range of networks including DSL, WiFi, 3G and 4G. Today, broadband is a very familiar term in the UK and all of our digital devices, such as smartphones, games consoles and internet-enabled TVs, use broadband to connect to the internet and share data all the time.

The function and use of digital devices

We would probably feel lost without the digital technology we now take for granted. Although technology is a global phenomenon, it is still not available or accessible to everyone. Some of the areas of life that have benefited from digital devices are discussed below. We will look at the function of digital devices for these different areas of modern life.

Education and training

Education and training traditionally were nearly always done face to face in a classroom. The emergence of digital devices has both expanded the reach of the classroom and also brought about different ways of educating and training people.

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If you attend a school or college, then it is likely that your teachers have used interactive white boards (IWBs) for front-of-class teaching. These IWBs connect to a PC as the input device and enable access to a wide range of features. If work displayed on the IWB is stored on a network, then it can be changed, drawn over, manipulated and saved to a central server.

You may have experienced using e-learning resources yourself. For example, perhaps your tutor has uploaded e-learning resources to a shared virtual learning environment (VLE) for you to study at a convenient time or so that you can complete an assignment independently.

Training is available as computer based training (CBT) on almost any subject one can imagine, from flower arranging to games programming. Enthusiasts use the power of YouTube and Instructables to record instructional videos on even the most niche of hobbies.

Large academic organisations have created massive online open courses or MOOCs to offer courses to unlimited numbers of people, and these are often self paced and certificated. Journals and research papers are available to a much wider audience now as almost everything that has ever been written has been digitised and stored somewhere or other.

The benefits of digital devices combined with the communications technologies today bring about unprecedented opportunities for collaboration, for example using services such as Google Docs and video conferencing and surveying tools.

Education and training can now happen remotely, anywhere in the world, without the tutor and students ever meeting. Virtual classrooms can be used in which the tutor communicates with students via web conferencing technology. The tutor and students can share access to class materials and a forum for class discussions.

Personal

Over the last few decades, the personal use of digital devices has transformed how people in society live. We are now able to communicate more easily, at the touch of a button or by means of our smartphones. Our personal digital devices are highly integrated into our lives and we can carry out many everyday tasks in moments, directly from our smartphones or tablets.

They allow us to communicate with friends and family anywhere in the world through phone calls, instant messages, email, voice-over-the-internet protocols (VolPa) such as Skype, and through social media applications. They allow us to create, edit and watch visual media in the form of photos and videos, and this is not confined to specialist devices (such as DSLRs) but is available to all on even the most basic smartphones. We can also read e-books using e-readers and tablets.

Digital devices also enable us to manage our lives through banking apps which allow us to make transactions remotely, and through the use of diary and alarm clock applications. It is now even possible to pay for small purchases by holding a contactless card or enabled mobile phone close to a terminal. Our digital devices let us access the vast information sources of the internet, wherever we happen to be so, for example, you can find an appealing restaurant nearby having never visited that place before that day. Your smartphone might even decide to tell you there is a great restaurant nearby using location aware services and targeted advertising. With the right software applications, we can operate our homes (the heating, lighting and entertainment system) without getting out of our chairs, or even if we are overseas with the growth of the interconnected home and the 'Internet of Things'.

The use of the humble smartphone to manage our daily lives also has its drawbacks. Natives of the digital age are often lost when their device fails or is forgotten, or the battery runs flat. Society today is so reliant and engrossed in technology that sometimes the real world takes a back seat. Living our lives online and being so connected brings with it brings some pretty big risks too. Security is a huge concern – it is all too easy to 'steal' someone's identity or gain access to control their home if simple precautions are not taken.

Social

Our social lives revolve around our digital devices and the world of social media that we can access on them. Many of us check our social media newsfeeds regularly throughout the day and well into the evening. We always want to know what new thing has been posted or tweeted by our friends, family and celebrities. We also use social media to make arrangements to meet up with friends and family and much of our social life with them is even conducted virtually through social media.

Some would say that our use of social media has become disruptive, destructive and occupies too much of our time. Before digital technology, we probably visited friends and family more often. Now it is often the case that, even when you visit people, you might spend time looking at social media rather than talking to each other.

Link

For more on social media, see Unit 3: *Using Social Media in Business*.

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As mentioned above, digital devices have given us access to vast amounts of information at the touch of a button. However, we are also bombarded by vast amounts of data that we do not request, such as spam email and unsolicited advertising on social media.

Research

The unwanted data that we are bombarded with was claimed in 2011 to be the equivalent of around 174 newspapers per day. Explore the amount of internet traffic there is nowadays; read the article on The Zettabyte Era on at www.cisco.com.

We are now so reliant on technology, which is often promoted as a time saver, that we seem to have less time than before. Keeping up to date with social media, emails and texts is very time consuming. It seems that we cannot go anywhere without some form of digital device, and need to be 'connected' all of the time. While our lives appear to have been enhanced by the digital revolution, it is worth considering what life might be like without it.

Reflect

What would your life be like without the digital devices you use everyday? How would you arrange to meet up with friends? How would you do research for a college project? How would you put together an assignment for college? (Putting aside the fact that you would probably be studying something other than IT.)

Retail

Retail operations have been made much simpler by digital devices. Consider how supermarkets use electronic scanners to read barcodes on merchandise rather than relying on a sales assistant to manually key the price into the till. Until relatively recently, shop assistants were required to perform mental arithmetic to add up the customer's purchases and work out the change required, but this is all done by digital cash registers now, and these usually have touch screens.

Supermarkets are employing new technology at a fantastic rate. RFID is being introduced to automatically track stock from factory to store. The technology exists to read every product in your shopping trolley simultaneously as you pass it through a special reader, eliminating the prospects of mistakes or theft. Large supermarkets have self-checkouts and scan-as-you-shop systems, where the traditional role of a checkout operator is eliminated. Contactless, Apple Pay and android pay are all RFID. Security systems can now track and identify people automatically by their facial features.

As you learnt earlier, electronic funds transfer at point of sale (EFTPOS) systems are used for transactions with credit and debit cards. We rarely require cash, and when we do we mostly use another machine, an automated teller machine (ATM), to withdraw money. These are often situated near or inside retail outlets.

Retailers, such as supermarkets, garages and clothing stores, that encourage us to sign up for loyalty cards, gather data on our preferences. They use that information to send us enticements to buy again and to promote products that might suit our lifestyle and preferences.

The barcodes on purchases update shop stock records, and automated systems ensure that stock is systematically ordered from the supplier without the need for human intervention.

Organisational use

Organisations use digital devices to support an extensive range of functions. For example, they use digital devices to carry out administrative functions such as:

- accounts
- sales
- stocktaking
- procurement (acquiring goods to sell).

Organisations also use digital devices to carry out a number of specialist functions in the following areas.

- Design – The design industry (textiles, architecture and furniture) will use computer-aided design (CAD) software to create their technical drawings.
- Manufacturing and construction – The manufacturing and construction industries use **CNC** machines for milling, turning, moulding and cutting materials with precision.

Key terms

CNC – computer numerically controlled (CNC) machines are automated using software programs to carry out precision production of parts used in manufacturing and construction.

Link

To learn more about CNC machining, see http://machcnc.co.uk/.

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Business have benefited significantly by using technology to speed up operations and the internet has enabled easy communication and access to information. Organisations can easily maintain links with suppliers, customers and their workforce, regardless of their location.

The internal and external dissemination of information is rapidly improved with technology. Central records are now stored on a server, which can be accessed remotely at any time, providing up-to-the-minute information. Geographical differences, time zones and cultures are no longer the barrier they used to be because all information is digital. Before the availability of digital technology, information was almost entirely kept in paper format and it would take considerably longer to perform transactions.

Discussion

In small groups, share your experiences of any part-time work you might do or your experiences as a customer.

What IT systems are involved in performing work tasks and transactions? Which replace older manual methods? Can you identify any businesses still relying on manual methods that are more usually carried out using technology today?

Discuss the advantages and disadvantages of the digital and manual methods.

Creative

The creative industries, one of the fastest growing sectors over recent years, have also benefited significantly from the use of technology. Consider the humble photograph and the time delay that used to exist between capturing an image on film and then getting it processed and the cost of the wastage created by taking numerous frames. Instead, we take digital images which do not cost anything to capture and we can easily delete those we are not happy with, freeing up memory on our digital cameras/smartphones.

Link

Technology has now also provided us with 3D imaging, which opens up many more opportunities to be creative. For more on 3D imaging, see http://www.wisegeek.com/what-is-3d-imaging.htm.

The media, music and film industries can now replicate sounds digitally and even edit them on the move. Computer generated imagery (CGI) and 3D computer graphics have revolutionised media productions and contributed to the rapid global growth of software developers, particularly in computer gaming. It is highly unlikely any computer games you enjoy now are 2D and you will probably have watched 3D films in the cinema or on a home TV.

Link

For more on the use of digital devices in the creative industries, see *Unit 8: Computer Games Development*.

Peripheral devices and media

This section is about the features and uses of peripheral devices and media in IT systems to meet the needs of individuals and organisations.

Peripheral devices used with other digital devices to form part of an IT system

A peripheral device is **hardware** that is auxiliary (supplementary) to the computer. If you can touch it, then it is hardware (and is therefore not **software**, although it may contain software).

There are different types of peripheral devices:

- input devices
- output devices
- storage devices – these store information externally from the computer and provide extra memory
- communication devices, for example, WiFi, Bluetooth, radio and serial ports.

Key terms

Hardware – computer equipment that you can physically touch. It includes computers and other digital devices themselves and also peripheral devices such as the keyboard, monitor and mouse.

Software – applications or programs which are installed onto a digital device. They enable us to carry out certain functions such as word processing or creating spreadsheets, using media, accessing websites or playing computer games.

Input devices

Input devices are those which interact with or send information to the computer. They may pass data to the computer but do not store data. The following are all examples of input devices which can be connected via a cable or wirelessly to a digital device.

- Keyboard – This can be connected to a computer, laptop, tablet or smart TV. Using the keys, users transmit instructions or input data into the digital device.

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- Mouse – This is a pointing device that allows users to make selections on a computer screen.
- Webcam – This is a video camera which transmits moving images through an internet connection. Webcams make it possible to see friends and family on the other side of the world.
- Microphone – This is used in conjunction with a webcam. A microphone allows us to transmit sounds across the internet or to give commands to the computer using our voices.
- Joystick – This is similar to a computer mouse. A joystick allows users to make selections or navigate through computer generated environments in a computer game.

The following are types of connection commonly used by input devices.

- USB – A Universal Serial Bus (USB) is a form of connection used for many peripheral devices. USB flash drives are data storage devices. A WiFi dongle, which is a USB peripheral, can also transmit a WiFi connection so can be attached to a digital device such as an internet-enabled TV to connect it to the internet.
- Bluetooth adaptors and wireless dongles – These contain radio communication hardware and will have some degree of firmware on them. They connect to other devices with similar connectivity which may allow a connection to the internet. A Bluetooth dongle is commonly used to add Bluetooth capability to connect to a device such as a mouse or headset.

Bluetooth adaptors transmit data over short distances and rely on software to connect to another device, whereas a wireless dongle contains firmware and connects to a USB port.

Output devices

Output devices provide information to the user from the computer. They perform a function using data or software stored in a computer. The following are all examples of output devices which can be connected via a cable or wirelessly to a digital device.

- Printers – Conventional printers are used to reproduce text and images according to instructions which they receive from any digital device. The printer receives data from the digital device which it replicates on paper. Three-dimensional printers are used to produce objects using materials such as plastic and even chocolate from instructions that they receive from any digital device.
- Monitors – A monitor is a visual display of whatever software and/or data is being accessed on the digital device at any given time. They are crucial to human interaction with computers, because otherwise we would not know what was stored on the digital device or be able to access the internet through it. Monitors show us how we are interacting with the digital device via a keyboard, mouse or joystick.
- Projectors – These are similar to monitors as they are visual displays of whatever is being accessed on a digital device. Projectors are used to project the digital display onto a white or silver screen. They are mostly used to project films in cinemas (commercial and home) and for presentations in front of large groups of people where there are too many people to gather around a small computer monitor.
- Speakers – A sound card converts digital signals into analogue signals which are then converted into audible sound by the speakers. They are used to listen to music or videos and enable users to hear people in other locations during web conferences.

Some devices are both input and output devices. Joysticks are generally input devices but you can get ones that have haptic feedback, which is an output. Haptic feedback is a tactile sensation that users feel in their hands in response to something happening in the software they are using. The most common use of haptic feedback is in computer games, as this enables users to feel sensations corresponding to things happening in the game, for example, crashing into another car in a racing game.

Storage devices

Storage devices are peripheral devices that are used for storing data for the following reasons:

- to save space on your computer's hard drive
- to transfer files physically rather than over the internet
- to share files with another person or another digital device physically (if a network connection is not available)
- to back up data in order to protect against damage or loss.

The following are examples of storage devices.

- External hard drives – These are used to back up data or to store large amounts of data. Digital devices such as laptops and tablets have limited storage space, so by storing data on an external hard drive you can increase your storage capacity.
- USB flash drives – These can store smaller amounts of data which you wish to keep a copy of, or they can be used for temporary storage when moving data from one digital device to another.
- SD (secure digital) cards – SD cards provide high-capacity memory storage in a small space. They are most commonly used in small digital devices, particularly for storing still images.

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- Optical disks – DVDs (digital versatile disks) are a form of optical disk technology similar to CD-ROMs. They are most commonly used to store movies. Blu-ray is an advancement on the DVD technology that uses different wavelengths and materials to realise a massive increase in storage capability.

Link

For more about the cloud, see Online systems.

Storage devices are often used as both input and output devices (they are known as I/O devices), which means that you can copy or transfer the data from the device as well as onto it. Some storage devices will not allow you to reuse them, so that you cannot change the data that is stored on them. These devices are read only.

Manual and automatic data processing

You may have heard the saying that what comes out of a computer is only as good as what goes in. Loosely speaking this is true. However, computers can read through optical character recognition, and can write through output of data. Also some of what comes out of the computer could be 'created' by the computer. Output is generated by the software, which was written by a person.

Tip

In your assessment, ensure that what you put into the computer is what you want to get out. Make sure that you always proofread your work or ask someone to help you do this, as a fresh pair of eyes often spots things you will not. You will also need to be exact when writing programming code, so make sure to check everything you write..

A computer has no decision making capability unless it is programmed in. A computer will only do exactly what it is told to do. Take, for example, a simple calculator which is a basic form of computer. It is very easy to assume that the answer a calculator gives must always be right. However, if the calculation or the figures which were put into it were wrong, then the answer will also be wrong. (The calculator will calculate correctly the figures put into it, but it will not know if these were the wrong figures.)

Despite the limitations, we would struggle to imagine life today without computers and their capacity to process enormous amounts of data rapidly.

Now consider examples of different types of data processing, both manual and automatic, that are performed by businesses.

Manual

The following are examples of some possible manual processes:

- keying in mail and telephone orders
- entering customer details from paper forms
- processing sales (checkout operators at a supermarket)
- marking exam scripts
- entering or collecting survey responses.

Automatic

Automatic data processing is data collection or processing carried out by a computer, sometimes with very little human input. The following are examples of uses of automatic data processing:

- smart meters (measuring electricity and gas)
- seismometer (used for predicting and measuring earthquakes)
- satellites (such as the Hubble telescope, observatories such as Mauna Kea and in the search for extraterrestrial intelligence (SETI))
- processing of ATM transactions
- race timing systems (RFID)
- bitcoin mining.

Accessibility devices

Accessibility devices are those which provide alternative input and output options for using digital technology when standard methods are not an option, for example because of a physical disability. They are also referred to as adaptive technologies. The following are examples of accessibility devices.

- Voice or speech recognition software – This software allows users to give instructions to digital devices or to input data using their voices (rather than fingers). It is particularly useful for anyone with a visual impairment or physical impairment to their hands. Examples of this kind of software are Express Scribe Free, Speakonia and Dragon. Many digital devices now have a 'personal assistant' which is controlled by your voice, such as Siri on Apple iPhones and Cortana on Microsoft products.
- Screen readers – This software will read aloud the words or content of the computer screen. This is particularly useful for people with visual impairments. The screen reader will read the words on the screen and also read out **alt text** for images and other media. Examples of this kind of software are JAWS, Supernova, Thunder, Window-Eyes and ReadHear, among many others.

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Key terms

Alt text – alternative text for an image or other media, for example on a web page or in an e-book. The alternative text is read by screen readers to tell the user what the image or other media depicts. Alternative text therefore needs to be descriptive and concise..

Link

Find out more about free screen readers at www.usabilitygeek.com.

- Touch screens – As well as touch screens being an interactive and useful way for anyone to input data into a mobile digital device, they can be of particular benefit for anyone who is unable to use a keyboard easily.
- Keyboards with big keys – Keyboards with big keys are useful for visually impaired people or for those who find it physically difficult to use standard keyboards.
- Ergonomic keyboard and mouse – Ergonomically-shaped keyboards and computer mice can benefit people who suffer with repetitive strain injuries when using a standard keyboard and mouse for long periods.
- Screen magnifiers – Screen magnifiers benefit those with visual impairments as they make it easier for them to read what is on the computer screen.
- Screen overlays – These are helpful for those with visual impairment or conditions such as dyslexia as they make the text easier to read by changing features of the screen, for example the background colour. This is an example of an in-built accessibility option in Microsoft Windows.
- Eye motion sensors, head motion trackers, sip-and-puff systems or light operated mouse and keyboard – These accessibility devices/adaptive technologies make certain tasks possible for people with significantly limited physical movement or paralysis. The choice of these devices will be dependent on the specific disabilities of each individual.

- Adaptive technology in action
- Keyless cars – This technology can be convenient for anyone but is also particularly useful for anyone with dexterity difficulties.

Research

Research where else gesture recognition technology is used or how it could be used.

Discussion

Stephen Hawking is one of the world's most famous people who relies on adaptive technology. You and your peers may know someone who requires specialist software or adaptive technology.

In a small group, list as many different types of adaptive technology that you can name and describe what they do.

Explore other limits to accessibility and seek out options which exist which are new to you.

As you will learn towards the end of this unit, legislation exists to prevent people and businesses from putting barriers in the way of anyone accessing technology.

Link

For more about accessibility legislation see Accessibility of IT systems.

Characteristics and implications of storage media used to form part of an IT system

Earlier, we started to consider the use of servers to store data. They are often used as central locations for software applications which are accessed by multiple users via networked computers, rather than installing the software on individual computers. Servers are most commonly used by businesses and organisations, such as schools and colleges, because they allow large numbers of people to share data, software and resources easily.

- Storage devices including USB flash drives, DVDs, CD-ROMs and external hard drives are most commonly used by individuals. Many businesses prevent the use of personal or transportable storage devices as they pose a risk to the business of computer viruses being spread across devices and of sensitive data being lost if it is only stored on one standalone storage device.
- Businesses usually have formal procedures in place for storing media centrally over a network so that other employees can gain access to information which needs to be shared. Certain protocols will also exist about the

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structure of that stored data so that it can be located easily by anyone using the network and for routine backups.

- Businesses use servers to store data on fixed disks. They usually also use a system called RAID (redundant array of independent disks) to spread data across a number of different physical disks. This has the advantages of both increased speed and redundancy if configured in the correct way. If a file needs to be accessed, it may be spread across 10 disks, which means that each physical disk only needs to read a tenth of the file, and this can happen simultaneously cutting down read times by a factor of 10. If one disk fails, the data can be reconstructed using the data from the remaining good disks.

Computer software in an IT system

This section is about the concepts and implications of the use of, and relationships between, hardware and software that form large- and small-scale IT systems. You will also consider the impact of IT systems on individuals and organisations.

Types of operating system

An operating system is the **platform** which enables software installed on a digital device to work. It includes the necessary functions which act as an **interface** between the hardware and the software. You will probably know about some of the operating systems that exist, such as those developed by Microsoft (Windows), Apple (iOS), Android and ChromeOS. These systems operate with graphical user interfaces (**GUIs**). You may also have heard of DOS (disk operating system), which was the first, most commonly installed operating system on PCs.

Key terms

Interface – a point where two (or more) systems meet and interact. In computing, an interface is a device or program enabling a user to communicate with a computer.

Platform – the operating system which enables applications or programs to operate on a digital device.

GUIs – graphical user interfaces are those which allow users to interact with a digital device using graphical icons.

Research

How do operating systems which do not run on a GUI principle work?

Real-time operating system

A real-time operating system (RTOS) is a system which processes data in current (real) time, for example, RTLinux and Windows CE.

Single-user single task

Single-user single task operating systems can only run one user application at any one time (such as on a basic mobile phone), unlike a smartphone, which runs several software applications at the same time.

Single-user multi-tasking

Single-user multi-tasking operating systems deal with multiple applications running at the same time, which is what smartphones use. For example, when you are using spreadsheets, word processing, surfing the internet and listening to the radio on your PC at the same time, you are demonstrating that the operating system you are using is single-user multi-tasking.

Multi-user

A multi-user operating system, for example Unix, enables several users to operate the same, or different, software applications at the same time, for example through a server. Cloud servers enable multiple users to contribute to the same document, such as a spreadsheet, at the same time.

Theory into practice

Keep a log of your computing activities over the course of at least one day.

Specify which types of operating system relate to each activity, each time you use a different digital device.

Share your list with a peer and discuss whether you agree about which type of operating system is being used in each case.

The role of the operating system

You have started to learn how operating systems manage many different functions. Operating systems also have functions to manage, in addition to running applications, and you will explore five of these here.

Networking

A networking operating system (NOS) controls access to resources and devices on a network. Networking operations include tasks such as managing remote printing, user management and backing up files.

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Link

For more information about NOS services, including the programming language used for early operating systems on different platforms visit

http://computernetworkingnotes.com/comptia-n-plus-study-guide/network-operating-systems.html.

Security

Operating systems that manage security run ongoing checks for attacks to the system and its software. They gather data, which is analysed and collated to form huge amounts of intelligence about the health of the IT system. Manufacturers of software collate this data to help with combating cyberattacks. They also use it to develop new software or to adapt existing software to make it more secure against attacks.

Discussion

How do you know whether your data and IT system is protected?

Discuss this in a small group. Consider what you can do to protect your data and IT system from cyber attacks.

Memory management

Operating systems require memory to run, and the larger the IT system, the greater the memory needed to run all its functions. This is the reason why multi-user operating systems run from a server (or collection of servers), because otherwise the computers would fail to operate efficiently. For an operating system to work, there has to be sufficient memory for its application workload, to enable it to work out how best to use the memory it has for conducting each task.

Link

For more about the types of memory that digital devices use, see Memory and storage in *Unit 8: Computer Games Development*.

Multi-tasking

The modern operating systems of today continually multi-task. Think of your classroom PC – it is constantly scanning for viruses, maybe allowing you to research on the internet while also editing your assignment work on a document and playing a selection of music, all at the same time. The operating system provides you with information about your system, such as how much storage remains or how much battery life is left in addition to the management of your running applications. However, a PC can in fact only do one thing at a time! So how does it multi-task?

Multi-tasking is managed by the operating system by allowing each process access to a tiny amount of processor time in turn. This happens so fast that it appears that it is doing it all at once. The downside to all of this is that there is only so much processing power and memory to go around, so things can begin to slow down when using lots of applications at once.

Device drivers

The operating system manages your peripheral devices by using a **driver** to link the digital device with peripherals such as printers.

Key term

Driver – a routine program used to operate peripheral devices such as monitors and keyboards.

Factors affecting the choice and use of user interfaces

User interfaces (UIs) provide a communication link between a computer's operating system and the user, whether the device is operated by using GUIs or by writing a sequence of programming code to perform each action. You will now consider the factors which affect the choice of UI, depending on the intended use.

Graphical

The majority of PC users are probably very familiar with using graphical user interfaces (GUIs), as Microsoft has a significant market share in supplying software and operating systems for personal and public use. As previously mentioned, GUIs allow users to operate a computer through the selection of graphical icons. Therefore GUIs enable users to operate their devices effectively without needing programming knowledge and with limited computing skills. However, because of this, GUIs require significantly more memory and power to operate than other UI methods.

Examples of GUIs

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Apple describes GUI functions as 'WIMP computing' (windows, icons, menus and pointer) and could be said to have revolutionised the way in which we use computers and digital devices. WIMP computing has made computer usage accessible to many billions of people of almost any age group by being an intuitive, easy-to-use UI, whereby users can perform multiple actions with little or no prior knowledge or training.

Command line

The command line is the starting point shown on a computer screen where programming code is typed, informing the operating system what to do next. Essentially, the computer is operated via the inputting of text, specifically commands. A command line UI provides more flexibility than a preprogrammed GUI, but requires the user to have knowledge of the OS specific commands to use it. The advantage of a command line UI is that it can be used to operate lower specification computers.

Menu based

Menu based UIs provide alternative methods to perform functions, through a menu, and require less memory than GUIs. They may provide additional options to those of a GUI but require user knowledge about which menu provides each function. Users who are less familiar with the software, or who are risk averse, are more likely to prefer GUIs to menu based UIs as a way to navigate and operate their devices.

Adapted

Factors that influence the choice of UI include the ability to adapt it, for example the options routinely provided by Microsoft for adapting the colour, font size and positioning of GUIs on the desktop. The ability to adapt a UI is an important factor for users, particularly if they have specialist needs such as a visual impairment.

Link

You will learn more about accessibility guidelines and current legislation in the section entitled Legal, moral and ethical issues.

Factors affecting the choice of operating system

You have already starting learning about some of the features of operating systems. These features will help you make a choice about which operating system is likely to be most suitable to meet your needs.

Most people will want to have access to a single-user multi-tasking operating system so that they can carry out more than one function at the same time, because such digital devices are more powerful and useful. PCs used by individuals and businesses will be single-user multi-tasking. Some businesses may also have access to a multi-user operating system for collaborative working, which will be accessed via a server or the cloud.

If you are planning to become a **software developer**, **data engineer** or an IT technician who problem solves network and security issues, you will need to interact directly with the operating system by using operating system tools and sometimes the command line. There are often quite accessible graphical interfaces in a modern server operating system. Microsoft Windows can almost be exclusively managed by a graphical interface as can modern implementations of Linux. A networking device such as a Cisco Router, however, is programmed solely by the command line through a terminal window.

However, if you (or a future customer of yours) interact with the digital device for the purposes of administration or leisure pursuits, then the operating system used will need to be configured for efficiency and usability. For a relatively new digital user or for someone who has little interest in anything more than basic functions which are simple to use, save time, enhance daily living or simply for entertainment, then a WIMP style GUI operating system is likely to be the appropriate choice.

Many individuals will also have one or more mobile digital devices such as a smartphone or tablet. Some of these may be single-user single task, but the majority these days will be multi-tasking.

RTOSs will be used by specific digital devices which require real-time data processing, such as GPS devices to enable people to navigate through traffic.

Key terms

Software developer – someone who contributes to producing computer programs (software applications) or computer games.

Data engineer – someone who designs and produces database programs known as information systems.

Factors affecting use and performance of an operating system

The amount of data you want your digital device to process at any one time will affect the performance of the operating system. A device running multiple applications and performing numerous operations, especially simultaneously, will use considerable amounts of memory and processing power (for example, a device streaming

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music and videos while also editing a presentation). In contrast, on a device used entirely for administrative purposes, producing spreadsheets and word processing documents will use significantly less memory and processing power. In both examples, the operating system is single-user multi-tasking, but the smaller amount of memory required and the fewer applications running simultaneously, the faster and more effectively an operating system can perform.

The amount of data analysis performed will increase the memory usage. A PhD student performing complex mathematical analysis on copious amounts of data for a major research project will require considerably better operating system performance than a book-keeper of a small business who has relatively small amounts of new data at any one time.

Utility software

Utility software is system software that runs alongside the operating system to distinguish between applications and to carry out routine tasks to maintain and optimise the system operation.

The purpose, features and uses of utility software

The purpose of utility software is to undertake routine tasks. The following are all examples of features and uses of routine tasks carried out by utility software:

- security checks
- identifying and removing viruses
- cleaning up files
- software updates
- backing up data
- issuing warnings or alerts that updates or backups are required
- managing peripheral devices (such as cameras, printers and webcams).

Another use of utility software is to gather data to clean up the system and speed up performance by searching for junk data and purging it (removing it) to free up storage space. Utility software varies in the amount of memory it takes up according to its features.

Factors affecting the choice and performance of utility software

Factors affecting the choice of utility software depend on what the user expects to get out of their device in terms of performance. If the device is mainly for browsing the internet or talking to friends using VOIP, it may not require utility software such as a printer driver. Users will choose utility software based on their needs. Most digital devices come with integrated software update processes but it will be up to users whether they choose to add security and virus protection or to set up backup utility software.

Factors which can affect the performance of utility software include the amount of memory available on the digital device for utility software, as mentioned above. Other factors include:

- bandwidth
- conflicts with other utility software (such as multiple antivirus applications running on one device)
- memory failures.

Application software

Application software enables users to interact with their digital devices to perform many different functions. They are constructed using computing programming code. It is highly likely that you use several applications every day, such as Microsoft Word and Excel, as well as internet browsers or apps on mobile devices. Other examples of software applications include specialist business software used to manage stock control or accounting functions. If you are studying computer programming, you may become familiar with programming software such as Windows Visual Basic, Python and Java.

The purpose, features and uses of application software

Since the development of application software, business processes have been greatly enhanced. Software applications enable businesses to cut costs, increase production and control quality through the use of automated digital processes and greater data processing power. There are also a number of businesses that benefit from the introduction of IT systems using application software that may not immediately occur to you. These include following examples.

- **Farming** – Software applications are used to manage harvesting, sorting, cleaning and packing produce.
- **Textiles** – Software applications are involved in the design and manufacturing processes used to produce textiles.

Factors affecting the choice, use and performance of application software

One of the many reasons why Microsoft products have been so popular worldwide is their versatility and usability (ease of use). Businesses needing general office applications mostly favour those with which the majority of people are familiar (and most people are familiar with Microsoft's Office suite), and those with interoperability. When employing administrative staff, it is easiest to only require previously learnt skills, such as how to use Microsoft Office applications.

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Apple products are most likely to be favoured by businesses in creative industries, such as advertising and graphic design, because the software that Apple initially designed had floating point processing power and excellent graphics capability that was more suitable for creative processes. Since then, they have built on that reputation. Some users simply prefer the design of Apple software although Microsoft Office operates on PCs and offers a version for Apple Macs. A great deal of industry-standard graphic, video and music production software is specifically designed for Apple Macs and takes full advantage of their unique capabilties.

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Home screens on different computers

Open source and proprietary operating systems and software

Behind all operating systems and software there is programming code, known as the source code. You may have come across this if you have looked at the source code of a web page in **HTML**. There are two types of source code that are generally created – open source and proprietary.

Key term

HTML – stands for hypertext markup language and is used to create web pages.

Link

For more on HTML see *Unit 6: Website Development*.

Open source

Open source code is a collaborative effort where more than one programmer contributes to the programming of the source code. It relies on peer review for testing its uses and functionality, and to fix any problems. Its main distinguishing feature is that the source code is open for use by anyone. Individuals can copy open source operating system and software code and, if they have the knowledge required, they can adapt it to their needs. Another distinguishing feature of open source software is that it is free.

Link

For more about open source, go to www.webopedia.com and search What is Open Source Software?

One of the implications of using open source software is that it can be copied and modified by individuals with a malicious intent, by expert programmers who do not share the same philosophy or responsibility to its integrity as the originators or simply by inexperienced programmers. However, this risk can be mitigated by individuals by checking the source of the open source code you download. On the positive side, open source programming provides opportunities for individuals to be creative and share their knowledge and expertise globally and freely. It gives access to sophisticated software to people who would not be able to afford the proprietary software. Developers of open source software do it 'for the love of good software', and bug fixes and feature developments are usually rapid.

Proprietary

Proprietary source code for operating systems and software, unlike open source, is privately owned. Examples of proprietary operating systems and applications are those produced by Sage, Microsoft, Apple and Pegasus. Proprietary operating system and software code will also have been produced by more than one programmer but as employees of a particular private company. Proprietary operating systems, software specifications and code are kept secret within a company to avoid copies being made and to stop modifications being made by anyone other than the company's designated programmers. Proprietary operating systems and software need to be purchased by individuals and businesses, but they are only able to use the operating systems and software, not change the source code.

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One of the main implications of using proprietary software is that it can be costly. Another is that it restricts development to particular employed or contracted programmers. However, because the developers have control over the code, they are able to gather data on problems which occur and can use this information to correct programming issues. They are able to create code 'patches' that can then be delivered to registered users of the software. (Updates are also possible with open source software: developers develop the code and users upgrade.)

The impact and features of user interfaces in computer software

User interfaces (UIs) are the front-facing link between humans and computers. The command line is the point at which the user enters command text sequences, to instruct the computer to perform a task. In the early days of PCs, the only way to operate the computer was to input a lengthy command, known as a string, at the initial prompt which showed on the screen when the computer was turned on, as shown in the picture below.

UIs have been revolutionised by the use of graphics (GUIs) so users do not need to input command line code. GUIs provide prompts and directions so that even the most novice user can operate a digital device with little or no training.

Possibly the most important and influential impact of GUIs in computer software is their universal accessibility, which enables billions of users to interact with technology by:

- increasing levels of technological skills even without formal training
- providing creative and effective ways for users who are disabled or who have specific sensory impairments to interact with computers.

The features of common file types and formats

The data within a digital device are divided up into different file types, for different types of data. File types help the computer determine which software should be associated with the file (that is, which software will be used to access the file) and how or where it should be stored. File types are automatically assigned to routine files. There are many different types and formats used for creating files and these are identified by a suffix following a filename and a dot. For example, you may be aware that Microsoft Word files are identified as '.docx' in the current version, whereas the Word template file type is '.dotx'.

Other examples of file types include the following which are used for different kinds of data.

- Image file types include:
  - .bmp (BITMAP)
  - .tif (TIFF)
  - .jpg (JPEG)
  - .gif (GIF)
  - .raw (RAW).
- Video file types include:
  - .mov (MOV)
  - .avi (AVI)
  - .mp4 (MPEG4).
- Application software files are saved using different file types, the most familiar being Microsoft Office's Word (.docx), Excel (.xlsx) and Access (.mdb).

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Use and selection of file types and formats

There are a number of implications on IT systems, individuals and organisations depending on the use and selection of file types and formats.

The method used for storing a file will vary according to the type of data it contains, the software used to access it and the type of file produced. Therefore decisions can be made about how you save a file in a different format depending on which will save memory, increase performance or, for example, retain the clarity of an image.

The implications of using and selecting some file types are discussed below.

BITMAP

BITMAP file types are associated with Microsoft Windows, although they are compatible with many other brands of software. A bitmap is a lossless image file format that does not lose quality or resolution. The downside is that it results in large files.

JPEG

JPEG files can be opened by most software applications and take up less memory than many other file types because the file is compressed when it is saved, losing some data and therefore quality in the process. Therefore JPEGs are particularly useful for attaching to emails, but the image quality might not be high enough for some purposes.

TIFF

TIFF files retain the quality of the image when saving, but TIFF files are not compatible with some software applications and so will not open and cannot be used in these applications. Therefore it is not the most versatile file type.

RAW

RAW files are uncompressed and the raw camera data. RAW file types can be used for images which require editing but require the relevant sophisticated software to open and manipulate them. The RAW file types are mostly used by cameras, specifically DSLRs, and each manufacturer has its own proprietory RAW file type.

PNG and GIF

PNG stands for portable network graphics. PNGs are file types which support lossless data compression. GIF stands for graphics interchange format and is a lossless format used for both still and animated images. There are patented restrictions on using GIF files, whereas the PNG file types do not carry the same restrictions and so are more commonly used. PNG file types can also be used as an alternative to TIFF file types.

Link

You will learn about lossless data compression later in this unit in Types of compression.

As with GIF and JPEG file types, PNGs were created for use on websites, each file type offering different levels of resolution. GIF file types do not support sophisticated animation such as those used, for example, in **Flash** files and often in logos. One of the benefits of using PNG file types, which were initially designed to replace the GIF format, is that software developers and web designers are not restricted by patenting laws as they might be when reading and writing other file types, such as GIF.

Link

To learn more about image file types, visit the Windows website, windows.microsoft.com.

Key term

Flash – authoring software used to create and play animated images.

MP3 and MP4

The MP3 file type only stores audio files, unlike the MP4, which holds both audio and video data of fairly high quality. MP4 files with video are significantly larger than MP3 files. However, MP3 and MP4 are not protected file types, which has led to piracy.

Link

To learn more about the difference between MP3 and MP4 files, visit www.differencebetween.com

DOC or RTF

Word processing documents can take the form of a document, such as Microsoft Word's DOC file type, or can be saved as a rich text file (RTF). Saving long and complex documents as an RTF is a useful tactic because they take up much less storage space than DOC files and is especially useful if the files are to be shared with users who have newer versions of software or different software makes. However, you cannot preserve a heavily formatted document in RTF. So if you wish to preserve formatting or tables and graphics, you will need to use the software file type.

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PAUSE POINT Think about what has influenced you in your choice of software and devices for your own personal use. What choices would you make now, based on what you have learnt in this unit so far?

Hint Identify the devices and software you use and make a list. Analyse and evaluate the advantages and disadvantages of each item on your list. Then consider which devices and software you might choose now.

Extend Create a list of the software and devices used at your place of study. You might want to choose a specific department to focus on. Identify the advantages and disadvantages of each in relation to the purposes they are used for and make suggestions for improvements. Compare with a peer and explain the reasons for your evaluations and recommendations.

Compatibility

Files of different types will not necessarily open in different software and may be incompatible. For example, you will not be able to open a spreadsheet in a word processing application and you may not be able to open a file saved in a later version of the software in an earlier version.

Emerging technologies

New technologies are emerging at a rapid pace. Consider that your personal smartphone will contain more computer processing capacity and software than the Apollo 11 rocket that landed on the moon in 1969.

Link

In fact, the computing power of the Apollo 11 rocket was less than that of basic calculators used in the early 1980s. For more about moon technology, visit www.itpro.co.uk and read the 'Man on the Moon: Technology then and now' article.

The concepts and implications of how emerging technologies affect the performance of IT systems

The extent to which technology can be developed appears boundless. However, some might argue that we have tried to run before we can walk by creating a world reliant on using technology before the world is fully equipped to be able to access technology or understand how to maximise even a small percentage of its capabilities.

The requirements of producing emerging technologies impact on the performance of IT systems because they put demands on our current systems, which in turn places demands on our environment and day-to-day living. In recent years, the launch of streaming media from a wide range of organisations has put enormous strain on already saturated infrastructure. The network providers have to plan ahead and expand the capacity of their networks to cope with the exponential growth in demand and use. The use of VOIP has again increased traffic but, in this case, a quality of service issue arises as calls cannot be delayed and must be given high priority when travelling through the hands of unknown couriers or organisations. Considerations include:

- technology is always expected to be on
- the exponential growth of data collection (big data) and the necessary processing and analysis of data
- the raw materials needed to manufacture IT equipment
- the environment needed to run electronic devices
- the infrastructure required for implementing and maintaining telecommunications and networks
- the cost of emerging technologies
- pressure on individuals to become **early adopters**.

Key term

Early adopter – an individual who feels compelled to obtain the latest products and technology as soon as they become available. For example, robotic vacuum cleaners, smart TVs and watches.

You will now explore the implications of emerging technologies on IT systems that are used by individuals and organisations.

Implications of emerging technologies on the personal use of IT systems

Ever since the 'birth' of the **worldwide web** by Tim Berners-Lee in 1989, and especially since the introduction and rise in popularity of smartphones and tablets, we have had access to more information on a daily basis than people from previous generations did in their entire lifetimes.

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Link

For more about the inventor of the world wide web, Tim Berners-Lee, visit www.w3.org.

Link

It is reported that 'almost one-third of the world's 6.8 billion people use the internet regularly'. To find out more about the invention of the internet, visit www.history.com.

While the **internet** as a communication medium is a wonderful invention and the emergence of the worldwide web making use of this has changed the way we run our businesses and everyday lives, it has impacted on the way we communicate with family and friends (through email and social media and less in person) and how we conduct our daily lives. We are now easily drawn into making snap decisions about purchases or enticed by promises of rapid wealth through social media advertising.

Key term

Worldwide web – also referred to as the Web, is a method of accessing information over the internet.

Internet – the networking infrastructure which enables communication and access to information between internet-enabled digital devices with potentially infinite range.

Link

Read more about the internet and the worldwide web at www.computerhistory.org and computer.howstuffworks.com. (Try searching for 'what is the difference between the internet and the worldwide web?')

Most of us can probably name an instance when IT systems have stopped working but, because we have learnt to rely on them, we overlook how we can manage without them. Examples of everyday tasks where we are now reliant on IT systems whereas, previously, we managed without include making a purchase, performing banking transactions, talking to friends and family, washing our clothes or keeping our homes warm.

Yet the benefits of emerging technologies for our personal usage on a daily basis are many, including:

- keeping in touch with friends and family by text, phone, email, VOIP and social media
- instant access to world news, TV programmes, films and music
- multiple functions contained in one single device
- the ability to take and store thousands of images using high-quality cameras which can be integrated into mobile devices.

Research

LG has recently (February 2016) launched a new smartphone, the first of its kind, which is modular in that plug-in modules can be purchased to add more functions to the device.

Research this technology and whether any other manufacturers have since developed similar devices.

Implications of emerging technologies on the use of IT systems in organisations

As referred to earlier, technology has massively impacted on the way businesses are managed. For example, it enables businesses to source supplies globally and to market products and services internationally. However, it is easy for businesses to become burdened with the high costs of supplying and maintaining technology, finding ways to accommodate expensive equipment and also to train staff to use these IT systems.

Nevertheless, there are also many advantages of investing in emerging technologies for businesses, especially for undertaking tasks that would have been high risk for humans to undertake. Examples include mining, extended space travel, carrying out delicate medical operations, or the use of unmanned devices to work in Fukushima or Chernobyl.

PAUSE POINT

What examples can you find of where farming has benefited from the use of technology?

Hint

Try searching the internet for the British apple farmer who uses digital imagery to sort 130 million apples.

Extend

Compare two examples of where technology is being used in farming. Identify the advantages and disadvantages of relying on technology, analyse the impact on the farmer and employees and evaluate how farming methods have changed since the introduction of technology.

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Research

Learn more about emerging technologies from BBC's Click programme.

Choosing IT systems

With so much choice and so many options, choosing IT systems can be complicated. .

The features of an IT system can affect its performance and/or the performance of a larger IT system, such as an IT system running two pieces of software which are incompatible with each other. One such example is the IT network used by the NHS. Currently, the software used by GP doctors' surgeries for keeping patient medical records around the country does not interact with and is not compatible with that used by hospitals to gather and store patient data.

Factors affecting the choice of digital technology

There are many factors that determine our choice of digital technology and these are discussed below.

User experience

When choosing an IT system, the experience it gives to the user is of particular importance, whether it is being used for personal or business use. User experience is the experience a user has of using a device or piece of software, and whether they have a good user experience depends on whether the device or piece of software meets their needs.

For example, an elderly person wanting to purchase their first mobile phone primarily for emergencies is likely to want a simple-to-use phone which makes and receive calls, has large keys and a clear screen with few, if any, other features. In contrast, an individual looking to upgrade their smartphone will base their decisions on previous experience and may be looking for additional or enhanced features such as extended WiFi range, screen resolution and memory capacity. Other factors, such as cost, will also be a consideration for users and, while many sign up for monthly payment contracts, an elderly person, as mentioned above, may be wise to buy their phone on a pay-as-you-go contract.

There are a number of aspects of user experience that will affect choices of digital technology.

- Ease of use – Devices or systems which are easy to use, or are more likely to save time are going to be preferred by most people, whether for personal or business use. Too many systems are overly complex and so only a minor portion of those IT systems are actually used.

Link

Other examples of complex systems are mobile virtualisation tools. To find out more, go to http://www.computerweekly.com/news/2240149820/Mobile-virtualisation-tools-unpopular-despite-IT-consumerisation.

- Performance – According to whether the technology is to be used for pleasure, business or academic research, the level of desirable performance will vary. The variety of functions a device can perform is also a factor. For example, an elderly person may want a mobile phone for emergencies only so will not need particularly good performance and will choose based on a single criterion. However, a business may make the choice based on high levels of performance if it requires its employees to be contactable while on the move. Employees may also need to be able to access a central server for customer records, to analyse financial data and produce complex reports. Therefore businesses make choices based on many criteria.
- Availability – People demand a service or an app that is there when they want it. Always on means always available. It is no good having a retail website that shuts when the shop does – one of the big advantages of e-commerce is that it extends your market. A retailer that was only open 9 to 5 in one town before a web presence would now be open 24/7 worldwide!
- Accessibility – Accessibility or adaptability of technology may dictate digital technology choices, especially if the user requires specialist devices such as speech recognition software, digital personal assistants or perhaps automated wheelchairs.

User needs

Users will have different needs which inform the criteria they use to make digital technology choices. For example, your place of study requires IT systems which may need to accommodate the needs of staff to use Microsoft Office software, communicate by email and store files on a central server. IT students will use computers for their studies, to learn about new software, to apply programming skills and to study networking techniques (access to a variety of digital technology is required for this).

Specifications

According to user needs, the system **specifications** will vary. Software designers may require different types of systems according to the tasks they are undertaking. For example, for programming they might use fairly basic systems, but they will probably want significant processing power and **RAM** for compiling programs or testing games.

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Key terms

Specification – this describes, in depth, the make up of an IT system.

RAM – stands for random access memory and is a form of computer memory.

Compatibility

Compatibility means whether two or more things that need to connect and interact with one another do so properly. If they do not connect (physically in terms of cables or connectors) or interact with one another (do not work together) then they are incompatible. Decisions about choosing IT systems will be based on the needs of the whole organisation. Just as you might choose the same make for several devices out of personal preference and because you know they will work together, businesses are concerned about compatibility and whether the IT systems they choose will interact with each other.

Connectivity

An individual, and usually an organisation, may choose a system based on its ability to connect to either a network and/or the internet reliably. Some individuals may only require their system for internet use, while an organisation may employ sales staff or engineers who spend most of their time on the road. These remote staff are likely to require VLAN access and mobile data. They will also need stable connectivity via, for example **Bluetooth** and **WiFi**, to communicate with customers and the organisation.

Cost

The cost of an IT system is very much a factor when making a choice. Businesses will allocate a budget for their IT systems. This budget is likely to include maintenance and upgrades. The cost varies according to the specifications and manufactured quality of the IT system. Cost is obviously an important factor for individuals too, and their budgets are likely to be much smaller than that of organisations. Quite often, manufacturers market their headline cost but businesses and consumers need to consider much more than this. Take a printer as an example – the cost of consumables varies a great deal between different manufacturers. Businesses will normally calculate the total cost of ownership (TCO) using standard formulae for the range of devices and not just look at the initial purchase cost.

Efficiency

How **efficient** an IT system needs to be depends on an individual's or organisation's users' needs. If a business is operating with low specification IT systems which underperform, it will take employees longer to complete tasks and this will cost the business money.

Key terms

Bluetooth – wireless connection which has a limited range.

WiFi – a system that enables connection over the internet between wireless internet-enabled devices.

Efficiency – a measure given to undertaking a task or activity with least wastage of time, materials or labour.

Implementation

Choosing a system can depend on the speed of its implementation. For example, an individual and organisation are likely to choose to use a system that runs the same software as they currently use for everyday tasks to avoid unnecessary time lost for training. The IT system will be chosen for performance, but also perhaps for space saving, mobility and weight, to make it easier to implement without having to find new locations for the system or to move around special equipment. However, if specialist software is developed, such as that being implemented in the NHS (http://systems.hscic.gov.uk/scr), it may require new IT systems to implement the change.

The urgency for implementing IT systems will influence choices.

- Timescales – The preferred IT system may not be readily available or the lead time for implementation may be too disruptive for the organisation or individual. Perhaps you decide that your personal computer is underperforming and you want to upgrade to one with greater performance but cannot get the same make as it is out of stock. In order to avoid a break in your studies, you may choose an alternative make or model because it is available straight away.
- Testing – It is hard and possibly irresponsible to choose an IT system without having tested it first. Depending on what it is needed for, you might want to test it for compatibility and stability. A keyboard user, rather than a mouse user, will probably want to try out the keyboard for touch, size and positioning of keys. Someone purchasing a GPS will want to test it for ease of use and readability in different weather conditions.
- Migration to new system(s) – Transferring data, software and files to a new IT system can be stressful as well as time consuming. The process of migration needs to be straightforward and reliable. Some suppliers include data migration as a service when purchasing a new IT system, perhaps transferring contacts, favourites and apps to another mobile phone for you. Even migrating to a new operating system can cause disruption and, when making choices about new systems, the OS for an individual or business can appear to be imposed on you whether or not you wish to migrate.

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Case study

If at first you don't succeed

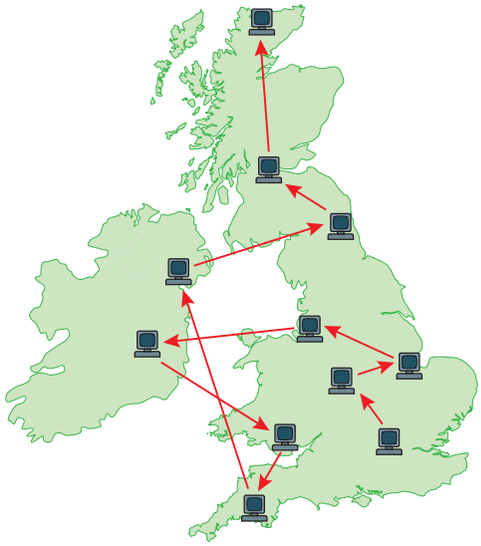

Figure 1.1: How systems can be linked geographically

The NHS is striving for efficient, improved IT systems which subsequently save billions of pounds. Due to the potential of digital technology and its functionality, the NHS intends to go paperless by 2018 by implementing a system which maximises electronic communication, such as:

- text messaging
- electronic prescriptions
- paperless referrals
- shared patient records across the country and with other social care agencies.

The NHS has experienced many problems with its IT systems over the years, reportedly costing nearly £10 bn. Some of the problems encountered with the systems include:

- old systems which are incompatible with replacements
- migrating patient records
- lack of integration with records held by other support services
- inability to share information across regions
- escalating costs for implementing and maintaining systems
- budget overspending due to compensation for cancellation of projects.

Due to the inefficiency of the current IT systems, there still remains a reliance upon:

- administrators to send out appointment letters to patients following doctors' requests
- patients having to explain conditions and medical history to doctors rather than patient records being readily available
- patients being relied upon to inform their GP of hospital visits and outcomes.

All of these slow down productivity, efficiency and, most importantly, patient care.

There are early signs that technology is being used more readily and automatically in the NHS. For example, images from X-rays and scanners are stored digitally, digital cameras are occasionally used to measure progress made during treatment and some doctors' surgeries routinely welcome emails from patients for repeat prescriptions. At some surgeries, booking appointments can also be arranged online while the telephone is also a means of triaging patients who may not require a face-to-face or doctor's appointment.

Check your knowledge

1. State why it is important for the NHS to change its IT systems.
2. Identify at least five reasons why previous NHS IT systems have been unsuccessful.
3. Name examples of where the NHS has already made improvements to its processes.
4. Give at least three examples of where standards could be improved by choosing the right IT systems.

PAUSE POINT How can digital technology improve current NHS processes?

Hint Read more about the NHS intentions by visiting
- Jeremy Hunt challenges NHS to go paperless by 2018', www.gov.uk
- The care.data programme – collecting information for the health of the nation', www.nhs.uk.

Extend How would you describe the concept of the intended NHS system? Tip: Try drawing your concept of the intended system.

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Productivity

Businesses very often make a decision to upgrade, change or implement new IT systems to increase **productivity**. Productivity in industry is a measurement based on the quantity of work carried out or products made in a given time period. For example, a Japanese farm near Kyoto (Kameoka farm) runs entirely without farmers, using robots to carry out all of the work. Productivity increased from an average of 30,000 heads of lettuce harvested a year to 10 million a year.

Link

For more about the Kameoka farm, visit http://spread.co.jp/en/factory/.

Security

IT system security is of constant concern. Frequent news reports feature examples of major breaches in security due to hacking into personal and business records. While we have become fairly savvy about the need for security software or using passwords to access IT systems and files, we remain less vigilant with mobile devices. Organisations will make their choices about IT systems according to the security precautions in place, especially where sensitive information is managed, such as police, health and financial records.

B Transmitting data

Computers process and transmit data either internally through the operating system or externally between digital devices. In this section, you are going to learn more about the concepts, process and implications of transferring data within and between IT systems.

Connectivity

Connectivity is the ability to process digital data by connecting the operating system with applications and systems and with each other.

Wireless and wired methods of connecting devices and transmitting data within and between IT systems

There are a number of different methods to connect devices and transmit data between systems wirelessly or using wired cables. Nowadays, we expect our portable devices to connect to the internet via WiFi automatically. When on the move, we rely on our digital devices to detect wireless signals and prompt us if we need to connect manually by simply choosing the network available and inputting a security code, if needed.

However, connecting devices by wired cables was the only option when computers were first being adopted by businesses. Computers, printers, scanners and web cams were all joined together by cables. It was usual to see cables resting on desks and along the floor to join digital devices together or to a server.

Within IT systems there is the need to connect peripherals and devices to perform input or output functions such as printers, keyboards, mice, webcams, speakers and monitors. There are a range of both wired and wireless technologies that enable this.

- USB – This is the most prevalent wired connection in today's IT landscape. It is a bidirectional bus which means it can both transmit and receive data and a single port can provide connectivity for up to 127 individual devices. One big advantage of USB is that it can also provide power to peripherals.
- Bluetooth – This is a wireless method often used to connect mice and keyboards as well as audio devices such as headphones. Its range is approximately 100 metres.
- VGA, HDMI, DisplayPort – These are video interconnects that permit connection of some form of visual display, such as an LCD monitor, projector or TV. HDMI also facilitates the transmission of digital sound and is becoming the standard in this respect.
- Parallel – This is older technology used to connect printers over very short distances.
- Serial – This is slow technology used for communication devices such as modems. It is also used to connect accessibility devices and to create console systems for commercial internet routers.

There are many available methods of communication between IT systems. Technologies such as WiFi and

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Bluetooth allow wire-free connection to a network, which might be a corporate network or be through your phone using 'tethering' and the 3G or 4G mobile data network. In businesses, wired connections are the most common form as they offer enhanced speed and reliability compared with wireless networks and, in some cases, they offer increased security.

We take for granted the functions that our digital devices perform to enable them to connect automatically and **sync** with other devices for access and so that data can be shared between them. For example, although we might own multiple digital devices, we can sync our data into one storage place so that we can access files, images and contacts whether we use our phone, tablet or even a smart TV. Usually, cloud storage is used to achieve this syncing of data.

Key term

Sync – is short for 'synchronise' or 'synchronisation' which means to match up and pull together, for example, to make sure that multiple devices have the same copy of the relevant files in many places.

When video recorders and TVs first became available to the public at more affordable prices, in the late 1980s, remote controls were also connected by a cable.

Link

For more about early television remotes, go to www.earlytelevision.org.

Remote controls using radio transmitted signals were first used by the military to control weapons in each of the world wars. Now all of our everyday remote controls for smart TVs and FreeView, Sky or Virgin boxes use infrared signals.

When the internet was originally available to the public, wired cables were used to connect computers and telephone lines to enable access the internet. The dial-up process was tedious, noisy and unreliable. Considerably less data was able to be downloaded then than can be today due to the limitations of the **bandwidth**. The introduction of broadband enabled quicker internet access with a faster response time and it gave people the ability to download large quantities of data fairly rapidly.

Key term

Bandwidth – the available amount of data transmission capability.

Theory into practice

Interview your relatives, neighbours and anyone living in a different area of the country from your home. Ask them about their experiences with technology and how they managed without in the past. Compare their responses and analyse the information according to, for example, their location, age group, gender. What similarities and differences are there and what evaluations can you draw from your findings?

We now have access to many different internet-enabled digital devices which we can operate wherever we are, assuming we have an internet connection. There are many different products available which enable us to operate our homes, even if we are on the other side of the world. We can turn the heating on and off, arrange for lighting to come on automatically or change the settings using our digital devices. If we are at home watching the TV, we can use any internet-enabled device to change the TV programme using an app and use smart TVs to access the internet.

How the features of connection types can meet the needs of individuals and organisations

Even though broadband is widely available and even taken for granted by many, there are many areas, even in this country, where broadband is either not available, has limited bandwidth or is not wanted or cannot be afforded by householders. For example, the information gathered by the Government in its last census of 2012 reported that 80 per cent of households have internet access. This meant that one-fifth of all households did not, at that time, have internet access. It would be hard to imagine life without internet access, particularly in the UK.

Link

For more about the census information on internet access visit the Office for National Statistics http://www.ons.gov.uk/ons/.

Theory into practice

Imagine what your life would be like without internet access. Try living without any form of internet access for a whole day. Find alternative ways of living without it. Keep a diary of what you did and the alternative methods you used. Share with a peer.

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Wired systems using cabling are still used to network computers together for shared access to servers, especially by businesses. In some cases, the connection to the internet is now shared with telephone lines through which broadband is received. In other cases, it might be cable broadband. Alternatively, people can use mobile broadband as their only means of connecting to the internet.

Businesses transmit data to speed up their productivity and efficiency using a mixture of wireless and **hardwired** or cabled systems. For example, vehicle manufacturers such as Mercedes Benz monitor the performance history of their vehicles which they gather remotely, directly from the vehicle. The vehicle also gathers data on its performance which is analysed by the processor in the vehicle and provides updates to the driver. The collection and analysis of this data enables more rapid and accurate diagnosis of problems. The manufacturer is able to automatically schedule servicing or replacement of parts before they become worn out.

Since the introduction of **fibre-optic** cabling and **4G** connectivity, systems for accessing the internet and streaming videos have become more reliable, quicker and effective than before.

Fibre-optic wiring increases the broadband speed, enabling users to utilise multiple digital devices in their homes and offices without experiencing the latency, unreliability or slow download speeds experienced when using traditional broadband connections. Since reports suggest that households own at least three different internet-enabled devices, on average, the demands on instant and reliable connectivity are increasing.

The development of 4G has enabled us to use multiple applications on mobile devices and to have a swifter connection to the internet than previously experienced. As yet, neither 4G nor fibre-optic connections are available to everyone because they are dependent on where you are located in the country and each connection type comes at an increased cost.

Link

Another type of 4G technology is referred to as 4G LTE which stands for 'long term evolution'. To find out more, visit www.pcadvidsor.co.uk.

Key term

Fibre optics – a collection of very fine **strands of** silica glass which use light to transmit data at high speeds.

4G – stands for 4th generation and is intended to replace 3G for accessing the internet at much higher speeds via mobile.

Hardwired – a permanent connection between components of an IT system with dedicated wired cabling. Modern buildings are often purpose built with the cables integrated into the fabric of the building and internet connections are provided for direct connection of non-mobile digital devices such as PCs, servers and machinery.

The implications of selecting and using different connection types

Recent advancements in technology may have made some internal cabling redundant (that is, internet cabling within houses and offices). However, in those areas of the country with limited bandwidth, the ability to access the internet via wires is still useful. Also, cables provide greater stability when using smart TVs and surround-sound systems, and can be hardwired directly into the device.

It was not until the late 2000s that some homes and offices were being built with cables embedded into the building infrastructure, so many businesses still show signs of trailing wires between IT systems. Increased health and safety requirements have raised awareness of the potential hazard from trailing cables.

There is a greater demand from businesses to have reliable remote connectivity for employees to communicate remotely between offices and across the world. Increasingly, more employees work remotely and interact with customers and suppliers around the globe at any time of day.

Such considerations are important when making choices about selecting different methods to connect digital devices.

The type of usage is also an important consideration when selecting the method of connection. In a warehouse, where staff are constantly on the move picking stock or collecting orders, then the use of WiFi with handheld computers would be an excellent fit. Likewise, using tablets to access live patient records at the bedside is better suited to a wireless technology, although security in this situation is a key concern, given the sensitive personal data that is being accessed. A business in the creative industry that produces advertisements and which is often editing high resolution video and imagery would benefit from cabled fibre to the desktop, so as to offer maximum speed of data transfer.

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However, most businesses are content with copper to the desktop as a middle ground of reliability and speed.

The impact of connection types on the performance of an IT system

Choosing a suitable connection type will impact on the performance of an IT system. This could mean the compatibility of the cables and their connectors to transfer data between digital devices or the ability of the software applications to interact effectively. For example, a business relying on the stability and speed of multiple systems to transfer large amounts of data, such as banks, government offices and the health services, will want the fastest broadband connection available, which is currently fibre optic. In the case of the Stock Exchange, reports have suggested that via changes to its connection types between companies with which it trades, the potential benefit to traders could be to the tune of £12bn a year. The ability for finance houses to get data across the Atlantic milliseconds before their competitors has the opportunity to significantly affect the profitability of trade.

In some industries, the reasons for choosing a more expensive connection type are not as obvious. There can be very high levels of electromagnetic interference as a result of some processes which would cause problems with traditional copper cabling; in these cases the added expense of fibre to the desktop is a necessity to prevent data loss and network degradation.

Research

Read more about how customers benefit from the changes to connectivity undertaken by the Stock Exchange, which increased customer access from 2Mb to 10Gb, at www.lseg.com.

Link

There are potentially negative impacts of connection types on the performance of an IT system. For one such example, read 'Six reasons why the NHS National Programme for IT failed' at www.computerweekly.com.

The DVLA's newly implemented IT system enables vehicle tax evasion to be reported to the police directly, whereas previously the two systems were unconnected. As a result, this has significantly reduced offending to less than one per cent. Previously, manual systems also relied on licensing requests to be serviced manually and paper tax discs were issued for cars. The intention for the DVLA to become completely digital has resulted in paper tax discs being abolished and has cut costs considerably in the administration processes. The DVLA forecast an 85 per cent take up in 2016–17, although this relies even more on individuals and businesses using online systems.

Link

To find out more about the DVLA's newly implemented IT system, read the 'DVLA Business Plan 2015-16' at www.gov.uk.

Networks

You have already started to consider what networking means and how or where it is used. You are now going to learn more about the concepts and implications for individuals and organisations of connecting devices together to form a network.

The features, use and purpose of different networks

This section discusses the different types of network and their features, use and purpose.

- Personal Area Network (PAN) – A wirelessly connected network between an individual's digital devices such as their smartphone, laptop, printer and car. This kind of network is used by individuals to sync their data across their devices for personal or business use.
- Local Area Network (LAN) – A local network which provides a connection between digital devices within a small area or building. The organisation 'owns' the communication links (cabling, infrastructure etc.) employed to support the network. It might be used to network two computers and their internet connection within an office.
- Wide Area Network (WAN) – A WAN uses telecommunications over a wider area than a LAN, with the potential to connect digital devices around the globe. The Internet is a collection of WANs. This global potential enables businesses to connect with each other across wider geographical areas such as the IT system now being used by the DVLA and police force in the UK. The advantage of a WAN over a cloud system for users is that it will be self-contained and can be made more secure, which is why organisations such as the police force use it. To connect using a WAN, the user usually pays a subscription to the telecommunications provider. WANs originally only transmitted voice but can now also carry data. The link uses telecommunications infrastructure that is not owned by the organisation.

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- Virtual Private Network (VPN) – This type of network provides a contingency for business expansion with little disruption to computing services. It works by using the internet to securely connect remote digital devices together. So it is useful for businesses whose employees work remotely around the country or at different sites internationally. VPN is a relatively recent development, replacing the need for dedicated communication links such as **ISDN** for home or remote workers. Instead, these workers can now use a public network such as the internet to 'pipe' a private (and secure) connection to their own LAN.

Key term

ISDN – stands for integrated services digital network.

Theory into practice

Identify at least one example of where each network type is used in different businesses, other than the examples given. What reasons can you give why these businesses would connect using the means they do rather than alternative methods?

Share with a peer and explain your rationale to each other.

What have you learnt from this activity? If you agreed entirely with each other, share with another peer or in a small group.

Factors affecting the choice of network

As with choosing an IT system, there are several factors which will influence the choice of network type. Some of these factors are discussed here.

User experience

- Ease of use – This is how easy is the network to use. Users are likely to choose networks that are easy for them to use or gain access to. For example, if certain types of network are hardwired in their building they are more likely to adopt them. Smartphone users are also more likely to keep to the same mobile phone network provider because of familiarity with their service. Users do not like overcomplicated processes. A device that connects automatically to a data service is preferable to a complicated configuration process that requires complex passwords or keys to be entered.
- Performance – Level of performance will be more important to some users than others, depending on the purpose of the digital device. As in the examples above, a video editing studio would require far more from their connection method than a corner shop. For example, if a user often has to use an internet connection to download significant amounts of data, then the user might choose a 4G or fibre optics for broadband connection, whereas an occasional data user would be satisfied with a (cheaper) 3G service.
- Availability – There are limitations to the availability of some network services, such as fibre-optic services and even standard broadband or WiFi. These depend on the locations of transmitters, especially in rural locations, and will affect the possible choices of network that a user can make.
- Accessibility – This determines whether a user can access data across a network, perhaps from a server or another device or perhaps access information from an **intranet** or **extranet**. You may be familiar with using the intranet at your place of study, possibly for information and resources uploaded by your teacher and for uploading your assignments for feedback. Accessibility can also mean how suitable a network is for particular users with specialist needs or a disability.

Key terms

Intranet – a local network website where access is restricted to internal users, such as within an organisation.

Extranet – an intranet system which can be accessed by authorised external users to retain data security.

Reflect

How would you make a choice of network for personal use? Make a list of reasons and rank these in the order you believe are most important to you, with the most important being number 1.

How would you make a choice of network for your school or college using the same process?

Discuss your evaluations with those of a peer.

User needs

The needs of the user vary with what they need an IT network for, whether they are an individual setting up a network for personal use or a business. Individuals use technology for different purposes. You are likely to use your digital devices in different ways and for different reasons to those of your family members. A family may need to share a network so will need one that will meet the needs of everyone in the family.

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A business will have similar considerations about network usage which will depend on the size of the business, number of employees and where they are distributed. If they have several office sites, they will want to transmit data and share files over the network, perhaps globally.

Specifications

Depending on the needs of the user or users, the specifications of the required network will also vary. Although office software is a fairly standard requirement, the versions installed will vary according to need. The performance of digital devices will also vary according to need: that is, the expected speed of connection, capacity and operating power required to undertake complex tasks will vary depending on the kind of business in question. For example, the specifications will be more demanding in a graphic design or music/film industry office than in one which is solely administrative.

Connectivity

An individual user might want to sync their digital devices together to share contact lists, files and photos and, according to usage, might want a more powerful broadband connection such as fibre optic. However someone else who just wants to use a tablet for browsing the internet or sending emails on occasions may prefer to pay a lower price for standard broadband.

As many businesses will need to connect to other offices across the country or globally for sales or suppliers, they will need to ensure that their access for the internet is very stable. Therefore they will need to choose a stable network and connection type. Businesses will also need to decide upon the size of servers, their type and the performance power of digital devices to be used in the network, depending on their business needs.

Cost

Cost is another factor in the choice of network – the higher the specification, the greater the cost. Some businesses and individuals prefer to make up their own specification for an IT system, whereby each component part is costed according to its function and performance, for example different types of **CPU**. It is possible, in this way, to get the same specification IT system for less money. However, it requires more technical knowledge and practical experience to set up.

Key term

CPU – central processing unit which acts as the computer's brain to process instructions.

Efficiency

The busier our lives become, the greater the demands we put on the technology we use. We demand maximum efficiency. Just as we are no longer satisfied with dialling into the internet once we have tried broadband, the same will be the case for those who use fibre-optic connections because they are more efficient: that is, they can download more data in the same time period.

Compatibility

Our choice of telecommunications network will depend on its compatibility to communicate between a variety of digital devices that we own. Any exchange of data will need to be in a format which each device understands. If a network is to be used to support workers who are constantly mobile, such as for quality control workers on a production line, then a fibre network is unsuitable. Some form of wireless technology would suit them better as they do not have a 'fixed base'. Likewise, WiFi is likely to be unsuitable for a data analyst working with large data sets due to the necessity for the data to be error free and available instantly.

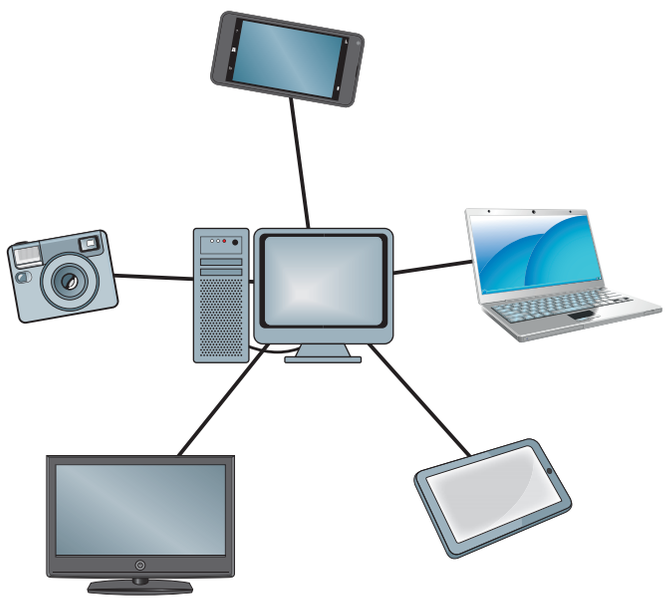

Figure 1.2: Compatibility between devices is important

Implementation

The decisions we make about the types and makes of device we buy and the telecommunications network providers we choose will be influenced by the ease and simplicity to implement them (set them up).

- Timescales – For a business time is money and the purpose of the installation will often dictate the timescale. A network installation in temporary buildings to accommodate seasonal demand needs to be installed quickly. For this purpose, wireless can be set up and

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running in minutes. However, for a permanent office, a more resilient structured cabling solution would be more suitable, but would take many days to install properly. Similarly, for external communications, temporary circuits in copper can be installed much more quickly than a permanent fibre-to-the-premises installation.

- Testing – A business needs to be able to rely on its network infrastructure as it is often the core holding every other system together. A properly planned installation will take into account this element of testing and a business might specify that the installation is categorised and certified to meet international standards as a way of ensuring reliability. A business IT system will also need to be tested and this may take a long time depending on the demands for the system. For example, testing needs to be carried out between digital devices for connectivity, especially if overseas. An individual will need to test their IT system, even on a very small scale such as using the internet or testing the time taken to upload and download data. If the download speed is too slow, they may choose to implement a different network.
- Downtime – This is a period of time when the digital devices or networks are out action, such as when the internet is unavailable, perhaps due to engineering works. Businesses and individuals want to avoid downtime as much as possible so a network that has significant amounts of downtime would not be chosen or would quickly be replaced. When considering the implementation of a network, the downtime that might occur when upgrading infrastructure needs to be planned in advance so that the business does not lose money. It might be planned for night times when demand is low, or might be carried out in phases so that parts of the network are unaffected while others are upgraded.

Productivity

Productivity means the speed at which instructions and data are processed, together with the quality of the outcome, for example the less downtime, the greater the productivity. The telecommunications network we choose is influenced by its performance and reliability, because we are likely to choose one that is more productive.

Security

Communicating over networks increases the risk to the security of that data. Simple precautions can be taken in the first instance, such as not sharing passwords and **encrypting** important or sensitive information. Businesses, as well as individuals, are likely to choose a network that provides them with an appropriate level of security for their needs.

Key term

Encrypting – converting data into a code to avoid it easily being accessed by unauthorised users. Specialist software is used to encrypt data.

Tip

Treat your password like a bank card PIN number – do not share it with anyone.

However, there are many examples of breaches in data security, for example in February 2015, the personal details of TalkTalk customers were put at risk of identity theft.

Your place of study will have an IT security policy and, depending on the restrictions imposed on the intranet, you may not be able to access the intranet when off-site or when using other digital devices.

How the features of a network and its component parts affect the performance of an IT system

A network is often made up of a variety of different components working together. The demands of the network make the choice of components critical, for example an enterprise network in a large company is unlikely to use products sold for the home market. A business needs their network to be resilient, and often auditable with redundant hardware to minimise the risks of failure, whereas a home user does not need the same level of resilience or auditing. For example, the failure of a core switch in a call centre employing thousands of people will result in those employees being unable to work, and customers unable to contact the company. The failure of your network switch at home is often just merely inconvenient. An enterprise firewall will log attacks and allow intervention and traceability. However, these features are not needed for home use.

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Issues relating to transmission of data

You have probably experienced issues with transmitting data on occasions. Perhaps the network connection has failed temporarily or a file will not attach to an email. Sometimes the files will not attach because the **email host** you are using has an internal problem, rather than it being an issue with the file size.

Key terms

Email host – an internet provider that offers an email service to its users..

This section is about how the features and processes of data transmission affect the use and performance of IT systems.

Reflect

What are your experiences and to what can you attribute the reasons why your connection failed? Is there anything you could do to prevent the situation happening again?

Protocols used to govern and control data transmission for common tasks

In IT systems, protocols are essential to allow systems to communicate. A protocol is like a language, that is, it is a set of rules governing how the communication takes place. The use of international standards and protocols allows devices of different manufacturers and operating systems to work with each other seamlessly. The protocol will dictate how the transmission is initiated, how data is encoded and how it is terminated. Just as when speaking to someone you begin a conversation with 'Hello', follow with sentences using your chosen language and end with 'Goodbye', data transmission follows a set pattern. We will look at some common tasks and the specific protocols that are used.

Email

When sending an email, you do not need to know what type of device your recipient is using – it is enough to know their email address. Email, by its very nature, connects people and devices across the world and it is likely that an email will pass through devices of many different manufacturers and operating systems before being delivered. The common protocols used by email are:

- post office protocol (POP3) – this is used to retrieve mail from a server by a mail client such as Mozilla's Thunderbird or Microsoft's Outlook
- simple mail transfer protocol (SMTP) – this is used to transmit mail to a server either from a mail client or another server
- internet message access protocol (IMAP) – this is used to access mail on a remote server by a mail client (the main difference between POP3 and IMAP is that IMAP does not remove mail from the server but merely acts as a method of accessing the mail)
- exchange – this is a proprietary protocol used by Microsoft with their Microsoft Exchange Server and Outlook; it works in a similar way to IMAP.

Voice and video calls over the internet

A common and popular way to communicate is to talk over the internet. There are a numbe of voice-over-the-internet applications such as Skype, FaceTime and Google Hangouts. They are especially popular because the basic functions are free to use. There are numerous providers offering paid-for voice-over-the-internet services which may vary in the service they provide and any charges they make. However, the connections can be unstable or unreliable and applications are not always compatible between devices, such as FaceTime which only communicates between Apple devices.

VOIP allows businesses and individuals to make financial savings by routing traditional telephone calls over the IP network (the internet) instead of using traditional phone lines. VOIP-enabled devices can often call VOIP addresses as well as traditional phone numbers. The use of standard protocols such as RTP and SIP (session initiation protocol) allow VOIP services from many different providers to work together seamlessly.

Web pages

Information about almost anything is now accessible through web pages, and it is estimated that there are over one billion websites online in 2016. It is the ease of access combined with the interactivity and immersive aspect of web pages that have made them so widespread. Web pages began life called 'hypertext pages' because text had links to other pages (hyperlinks). The protocol used to transfer these pages therefore became http (hypertext transfer protocol). The http protocol describes how a

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web browser requests pages from a server using a GET command such as *GET /index.html HTTP/1.0*. The server responds with a response code (you have probably seen the dreaded 404 response meaning File Not Found). The more normal response is 200, which means OK. A special version of http exists called https which is a secure version used for applications such as banking and the transfer of sensitive data. HTTPS makes use of SSL (secure sockets layer) or TLS (transport layer security) to encrypt the data transfer using public key cryptography.

Secure payment systems

The world of e-commerce as we know it is made possible by consumer confidence in safe and secure payment. Secure payment relies on much more than just the secure data transmission provided by https. The process of payment also needs to be secure and safe from phishing attempts and social engineering. Possibly the most well-known secure payment system is PayPal which uses the internet to undertake financial transactions in real time. Users need to register with PayPal and provide details of their bank and/or credit cards. When making payments they then need only log on through PayPal rather than giving out their sensitive payment data to other organisations. PayPal has built in protections and is incredibly popular for consumer-to-consumer transactions such as online auctions.

Link

For more about PayPal, visit https://www.paypal.com/uk/.

However, PayPal has experienced problems, for example reports during 2015 say that the site was down at one point for two hours and therefore unusable. This can occur when servers are down or because of with problems connecting to other networks.

Link

For more about the problems that PayPal, like many other websites, have experienced, visit https://downtoday.co.uk/paypal/.

Fraudsters often target users randomly by emailing them with claims that they need to share personal data in order to resolve account issues. Examples of where this occurs not only relate to PayPal but also include banks, building societies and HMRC. With regards to HMRC, the spam emails often claim to be tax overpayments which will be paid directly into personal bank accounts once you have shared your bank account details by return of email.

Businesses such as banks also provide secure payment systems, for example paying by credit or debit cards using a PIN number and making payments using their purpose-built banking apps. However, these are also open to abuse because credit and debit card details and PINs can be stolen. Banks providing online systems use techniques such as only requesting characters from your passcode rather than the full code or by using a 'challenge response' system using dongles such as the one available from HSBC.

Tip

You should never reply directly to emails from your bank or other organisations such as HMRC which request you to email them your personal or financial account details. They are almost certainly fraudulent. You can check the authenticity of any communication with the company via their websites (do not use telephone numbers provided in the potentially fraudulent email).

The British police also provide a dedicated website for reporting scam emails: visit www.actionfraud.police.uk

Security issues and considerations when transmitting data over different connection types and networks

As we become even more security conscious, those who specialise in hacking into IT systems strive to find alternative ways to break through security systems. Examples include the cyber attack suffered by Serco in 2012 on US federal retirement plans.

Link

For more about the cyber attack on Serco in 2012, visit www.securityweek.com.

Businesses routinely transfer sensitive data across their data networks and security of this data must always be considered carefully. It might be that simple encryption is employed or more sophisticated security depending on the perceived risk of the data being transferred. For an internal corporate network, security must start at the physical level, as protection of the physical network prevents simple eavesdropping attacks. For example, it would be prudent to ensure that any network ports in public areas are not enabled. Similarly, links between sites need to be adequately secured. A fibre link could be employed, as fibre is inherently secure because it cannot be 'tapped' in the same way that a copper cable can. Once data leaves a corporate network, then security is out of the

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business's control; because of this it is essential to consider how to protect this data when travelling over a public network such as by email. Email is sent as plain text and readable by any servers along the way. There are some secured networks, such as the GSI or government secured intranet (email addresses ending in .gsi.gov.uk) used by government departments, within which you can be assured of security.

Encryption and digital certificates allow security for data sent across public networks if this is essential. Tools such as PGP (pretty good privacy) allow easy access to encryption tools.

Factors affecting bandwidth and latency

Bandwidth is a measure of the data carrying capacity of a network connection. This may be your external broadband connection or even an internal corporate network. The speed is measured in bits per second (bps) and is often quoted in megabits per second (Mbps). A connection speed of 10 Mbps means that a connection can theoretically carry 10 Megabits of data each second. The performance of a connection is also sometimes expressed by quoting the **ping** time, which is calculated as the time taken to reach a destination and return (measured in milliseconds). A lower ping time is best; high ping times mean increased latency on your network. Your bandwidth will impact on the speed at which data is transmitted and other actions such as downloading or streaming of videos actions can be performed. Reasons for variation in bandwidth include:

- time of day (there are different loads at different times of day - for example, first thing in the morning, many people will be logging on to check emails)
- distance to your nearest telecommunications exchange
- volume of data being transmitted overloading the network
- hardwiring is usually faster than wireless.

These factors can result in increased **latency** of the system or connection.

Key terms

Ping – a test of end-to-end connectivity, which times the return of an ICMP packet between two hosts.

Latency – the 'delay' experienced, for example, when playing online games. High latency results in you seeing the movements you made to a character a longer period of time after you made them..

The implications of bandwidth and latency on the use and performance of an IT system

If a business relies on international communications, it might be decided to transmit a large amount of data at a particular time because there will be a greater bandwidth available due to the daily peaks and troughs of international data links. A system with high latency can cost businesses enormous sums of money and loss of business. For example, an aircraft relying on stable and reliable connections with air traffic control could face a major disaster if the IT system was subject to increased latency as critical systems like this rely on real-time control.

Link

Technological failure is often blamed for air disasters, whether it is the cause or not. To find out more about technical failures involved in air disasters, go to www.tibco.com.

Types of compression

Data can be compressed so that it takes up less space, and uses less bandwidth, when being transmitted across a network. There are two types of compression:

Lossy – Lossy means removing data, that is, data is lost in order to compress the file (make it smaller). As data is lost from the file this may result in loss of information. For example, if an audio file loses too much data, then it will not sound good. Image files saved in the file type JPEG will be lossy (they will contain less data and therefore be of a lower quality than the original RAW image file). The compression algorithm works to remove data that would be less noticeable. For example, in an MP3, it removes sounds that would be virtually inaudible due to the presence of other overpowering sounds – this is why some audiophiles often say that MP3s do not have the same feel.

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- Lossless – Lossless is the opposite to lossy. It reduces the size of the data file by filtering out unnecessary data by reducing the number of **bits**, rather than by losing relevant data. In essence, it is squeezed rather than cut down. Lossless compression includes, for example, the compression of a file or files into a zip file.

Key term

Bit – short for binary digit. Bit is the smallest component of data represented as a zero (0) or a one (1).

The applications and implications of data compression

Lossy compression is used, for example, in cameras and DVDs, and overwrites any previous formatting. Therefore it can reduce audio or visual clarity of the file. Applications for lossy compression include:

- MP3
- WMA (Windows Media Audio)
- JPEG
- AAC (advanced audio **codec**) which is a newer addition popularised by Apple and considered superior to MP3.

Key term

Codec – a device or program that compresses data for faster transmission.

Link

Google developed WebP for Android combining both lossy and lossless compression. For more information, visit www.developers.google.com.

Applications for lossless compression include:

- Windows Media Lossless
- FreeMp (free audio player).

Programs such as Microsoft Office include the option to compress a file as a zip file or to save as a different file type. Unlike lossy compression, lossless data can be retrieved and saved in other formats without loss of quality, as uncompression recreates a new file as it was.

The use and implications of codecs when using and transmitting audio and video in digital format

Codecs encode and decode data. Sometimes this results in the compression of data but sometimes it is just digitally encoded. Transmitting or storing encoded files is significantly quicker and takes up far less space than pre-codec. For example, smartphones have the capacity to store numerous videos, music, other audio and data files and images.

Audio and visual codecs are revolutionary in the way that digital audio is compressed while retaining, and even improving, quality by removing unnecessary sounds or silences.

Compatibility is the main implication – you need to be certain that the intended recipient is able to decode the data in order to be able to view the video/listen to the audio. Another problem may be if there are bugs in the codec program itself.

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Case study

The sky's the limit

The world's largest and most powerful observatory

In the remotest group of islands in any ocean, the big island of Hawaii is home to the world's largest and most powerful observatory. Situated about 2,000 miles from mainland USA, the observatory and its 13 telescopes are located on the volcano of Mauna Kea which measures, at its peak, 32,000 feet from the ocean floor. The telescopes are used by researchers to study the universe.

The reason for choosing the highest volcanic peak in the world for situating these observatories is due to the purity of the air and cloud conditions. This enables greater access to gather astronomical data for processing, some of which is undertaken by its headquarters in Hilo, the capital of Hawaii. However, due to location, the observatories are exposed to extreme weather conditions including strong winds, rapidly changing temperatures and snow.

These telescopes rely on digital technology to receive, transmit and analyse data that is collected as light and other waves. Surprisingly, scientists and astronomers rarely look directly through these telescopes as the information gathered by computers is invisible to the naked eye. The telescopes can be used to track satellites as well as identify stars and give scientists information about their speed, size, age and distance. Telescopes do not usually store data, but act as an interface, transmitting data to computers.

Satellites rely on technology when they transmit data from distances further away from Earth than can be observed by telescopes on Earth. The software between all devices must be compatible or translatable for computers and scientists to interpret the results.

Probably the world's most famous telescope is the Hubble, which has been orbiting Earth since 1990. It is the 'length of a school bus and weighs as much as two adult elephants, (www.nasa.gov/) and takes its energy from the Sun. When it was first launched, it had problems with a mirror which affected the clarity of images. This problem was fixed but, due to its age and technological advancements, the Hubble is going to be replaced. The Hubble transmits about 140 gigabits of data per week (**http://hubblesite.org/**) but there are problems with gathering data because this is distorted by the Earth's atmosphere. Latest technologies will enable increased data transmission and overcome the problems with distortion for more accurate and frequent data gathering.

Check your knowledge

1. State what type of connectivity enables the transmission of data between telescopes and observatories.
2. Interpret the connectivity between a telescope, observatory and astronomers.
3. Give at least four factors which could affect transmission at Mauna Kea.
4. Describe the reasons for replacing for the Hubble telescope.

PAUSE POINT What have you learnt about networks and transmitting data from this case study?

Hint Identify and list the different factors that affect networks and transmission of data. You can add to your list as you continue to gain new knowledge.

Extend What similarities and differences can you identify when comparing networks for data transmission at Mauna Kea with your own personal use?

Tip

Explore websites about Mauna Kea and the Hubble telescope to expand your understanding.

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Assessment practice 1.1

A01 A02

You meet a fellow student in the refectory and get chatting about the courses each of you are studying. Kamelia has just started a foundation degree course in zoology and hopes to specialise later in the study of amphibians. She is pleased to make a new friend as she is homesick and has little time for socialising. Kamelia shows an interest in your studies and asks if you would help her to make a decision about the technology she should use and how to get the most out of it, while spending very little. With Kamelia's help, you produce a list of criteria identifying her needs:

- method for networking laptop, phone and camera
- connectivity enabling WiFi access while in Malaysia, on field trips, and in the UK
- maximising storage space, especially images
- securing data against loss and attacks
- options for finding research material, storing, processing and printing findings
- ways to meet like-minded people.

Kamelia also tells you that she might be able to use part of a grant she has been given to purchase some software or technology, providing it adds value to what she already has. She also tells you she is colour blind and that English is not her first language. She wants to know if there is anything available now, or possibly being developed, to help her.

She will be learning more about photographing wildlife and possibly underwater photography, but wants to make sure that the images retain their clarity. She also tells you that she will be studying when back in Malaysia as well as on the move and wants to be sure that she has sufficient bandwidth to send large files to her tutors for assessment.

As Kamelia admits to having a fairly basic understanding of computing concepts, she has asked if you would be able to:

- identify options
- explain clearly what they are
- demonstrate how networking concepts work by drawing a diagram
- produce a short checklist as a troubleshooting guide of simple things that are likely to go wrong and what to do about them.

Plan

- What is the task?
- What are the success criteria for this task?
- Are there any areas I think I may struggle with in this task?
- What resources am I going to need?

Do

- I have planned my time appropriately to do my research and complete the task.
- I can identify when I have gone wrong and make amendments to improve the outcome.
- I set milestones and evaluate my progress and success at those intervals.
- I provide a glossary of common technical terms.

Review

- I can assess what went well and what I need to improve.
- I can explain why I went wrong or struggled in some areas more than others.
- I can identify what I have achieved by undertaking this task.
- I know what I need to learn next.

C Operating online

Many of us rely on the internet for work (communication, marketing and selling products or services) or in our personal lives (to communicate with friends and family through video calling and social media, to stream music and videos, and to browse and shop online). During downtime of our IT systems, our activities are interrupted and this is not just frustrating but costs businesses money due to loss of productivity. In this section, you will learn about the implications for individuals and organisations of using online IT systems.

Online systems

First, you will learn about some of the features, impacts and implications of the use of online IT systems to store data and perform tasks.

The personal and professional uses and applications of cloud storage

Cloud storage operates like a virtual server, providing the user with connectivity (through any form of connection:

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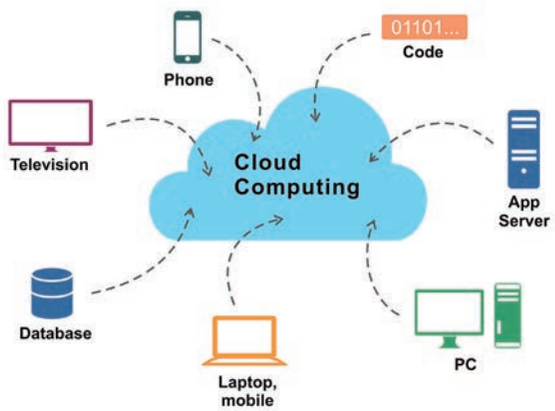

Figure 1.3: Cloud storage allows you to store and access files across different platforms.

commonly an internet connection) to the cloud storage system selected, such as those provided by Microsoft, Google and Apple. Cloud storage provides a massive amount of space by using numerous servers all linked together. You may have experienced problems attaching a file to an email which exceeds your quota and so, instead, used cloud storage applications such as Dropbox or Google Docs. These applications allow you to store files on a cloud storage profile to which you can give others access. This enables you to transfer large files to them.

Cloud storage is not an infinite resource and nor is it totally free. Some smartphone manufacturers have offers linked with cloud services, for example Android handsets are linked with Google Drive and Windows phones have additional space on OneDrive. Providers of cloud storage entice you to use them without making an initial payment, allocating you a limited and fairly small space. Then when you get close to exceeding the limit, you are sent alerts to increase the storage capacity for an additional fee, which is often an annual subscription payment.

Personal

If you have a smartphone, it is possible that you back up your data to the cloud, either by choice or automatically. Doing so provides a virtual backup for your contact lists, emails, calendar, music, and image files. You might also choose to back up up your data files from other digital devices, such as a PC, to the cloud rather than have a separate hard drive. This means that you can access your files anywhere, providing you have access to the internet.

Cloud storage can be especially useful for sharing photos of special occasions, which is made simple by uploading and sharing the link for the photos with those you choose to have access to view the images. Both the person uploading the photos and those receiving an invitation to view them are taken through each stage of the process in simple terms, making no assumptions about their technical knowledge or expertise. Images can be viewed on internet-enabled devices such as phones, tablets and smart TVs.

Professional

Many businesses also use cloud storage for backup, enabling their employees to access files remotely and at any time. Cloud storage is especially useful for employees who travel on business and rely on numerous digital devices to carry out their business functions.

The British Government reported in early autumn 2015 that millions of commuters now use free WiFi on public transport in the UK. This means that commuters with cloud storage can sit on public transport and carry out work while on the move.

Reflect

Do you use cloud storage? If so, what do you use it for and how?

Theory into practice

Explain to someone who is less familiar with using the cloud (perhaps a family member or friend) how to use it, its advantages and possible disadvantages.

Reflect on how clear your explanation was. How could you improve on your articulation of a technical instruction to a less technical individual?

The personal and professional uses and applications of cloud computing

Cloud computing provides access to software, resources and information via a virtual server, as with cloud storage. It is often referred to as being 'available on demand' although, of course, cloud computing also relies on having a suitable network connection, often to the internet. As there are increasingly more WiFi hotspots available and more and more people have access to 4G devices, they are able to access files, chat to friends and browse the internet while on the move.

Link

One example of a cloud computing company is The Cloud. You can find out more about The Cloud by visiting https://www.thecloud.net/.

Personal

Cloud computing saves people money and space on their own digital devices because they do not have to physically purchase and download software which then needs to be

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stored on their device. Instead, they pay a subscription to use whatever software and resources they wish, depending on the specification of their contracts. They need not bother themselves with downloads, upgrades of software, backing up their data and purchasing individual security software as this is all taken care of by the provider of their cloud computing service. You might imagine cloud computing as having a technical team on hand day and night looking after your system.

There are also lots of free cloud computing applications that only perform limited functions, but, used in combination, they can provide people with similar capabilities to paid-for cloud computing services. However, the users need to manage their applications a little more and ensure that they have adequate security on their devices. Examples of uses of the cloud include Google Docs and Office 365.

Professional

Although a cost is involved in cloud computing services, businesses may view the cost as significantly less than the cost of purchasing individual software and licences for each of their employees. Businesses also save time because preparing computers with the necessary software and making them ready to operate takes longer than if staff are given access to an online cloud computing service account. This approach to mass purchasing (in this case, of a cloud computing service) results in significant savings due to economies of scale, rather like the savings that can be made when purchasing in bulk through a cash and carry outlet.

Many businesses run their applications using cloud computing, rather than installing them onto a server or individual computers on their premises. One of the benefits to accessing applications through the cloud is that demand on processing power and storage is never exceeded, whereas, on a local server, these often would be exceeded.

The use of cloud services such as Microsoft's Azure or Amazon Web Services allows businesses to dynamically scale the available server capability to meet the demand. Retailers experience huge peaks of demand on events such as the Black Friday sales and the use of this scaleable power ensures they do not lose out on sales when their own servers cannot cope with demand. They only pay for the power they actually use so need not plan for or anticipate this demand.

Employees who use applications through a cloud computing service are able to collaborate on documents in a way that is not possible using traditional software that needs to be downloaded onto individual PCs. This is one of the biggest advantages of the cloud. Members of a team can concurrently (at the same time) type into and update documents that they are working on together, so improving productivity and avoiding the need to have multiple versions of a document which then need to be pulled back together again (which might result in discrepancies). All changes would be saved and tracked using one single document, rather than multiple versions which relied on an individual to coordinate. The team members do not need to be in the same office to work on cloud-based documents but can make changes and contribute to content or structure while working remotely and in real time.

Working in this way does come with the risk that you expose the document to errors as there is no control over what changes are being made and you cannot easily undo large changes (as others may have made changes since you made yours). Therefore consideration should be given before setting up documents as to what their purpose is and whether it is best to use cloud computing or whether to use the traditional method of one individual creating a document which is then uploaded and commented on by others (using cloud storage but not cloud computing). For example, if you are producing a textbook, it would be best to use the traditional method so that version control is maintained. However, if a team of work colleagues are updating a log sheet indicating whether they are in the office that week or working from home, which is useful for everyone to be able to see in real time, this document could be created and managed via cloud computing.

The impact and implications on individuals of using cloud storage and computing

Cloud storage and computing provides flexible access to data and applications, although it can come at a price. As an individual, you may have limited cloud storage included in your telecommunications contract and can pay extra for increasing the storage limit on your mobile digital devices. For personal users that own many connected devices, the ability to use the cloud to keep all devices in sync is invaluable. Each user need only maintain a single calendar and have it available on their home and work PCs as well as on their smartphone. However, applications such as Google's Gmail and Docs are free and provide ample cloud storage and computing features for most personal use.

Using the cloud is not without its concerns, especially regarding security or downtime. Without access to the internet you will not be able to access your data, so to ensure constant access you need to pay for a reliable connection. You should use appropriate safeguards to store financial or sensitive information on the cloud, even if it is encrypted.

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The impact and implications on organisations of using cloud storage and computing

There are obvious benefits to businesses of using the cloud storage and computing which include the following:

- provides unlimited storage facilities
- reduces costs
- reduces the need for specialist in-house IT support
- enables employers to focus on core business objectives rather than technology
- provides flexibility in terms of meeting the needs of the workforce: for example they are able to hold virtual meetings over Skype or make contact with customers using chat rooms, emails and by sharing files easily, as well as collaborating on files.

Managers need to compare the cost of using the cloud with the cost of purchasing and maintaining their own servers. They should also consider the benefits of knowing that the responsibility and expertise needed to maintain and develop the cloud does not sit with them but with the cloud computing service. A new start-up is probably unable to afford the intial expense of powerful servers and processing so can use a cloud service to host their new platform without the worry that it will not cope. AWS (Amazon Web Services) offer a range of plans where users are billed according to the actual bandwidth and processing power used. This allows the company to meet the demand without paying for something that may never be used if an idea does not take off. If a new business idea does take off, then the service will dynamically scale up to cope with the new traffic and demand.

However, as with individual use, concerns continue about potential loss of data and breaches in security. Businesses will have policies on what they perceive to be acceptable practice, such as:

- using business cloud computing/storage for professional use only
- contingency plans for periods of downtime
- what information is not to be stored on the cloud, such as financial and government documents.
- Some businesses may choose to store sensitive data files using the cloud if they believe that the security risk is greater if they were stored locally on their premises.
- During any system maintenance or upgrading, the cloud provides a less disruptive option for businesses. Any downtime will impact on a business's ability to carry out its functions and any employees who are working remotely may also be affected during these periods, as they will not be able to access files stored on the cloud.

Systems that enable and support remote working

There are two important types of IT system that enable and support employees' ability to work remotely. These are virtual private networks and remote desktop technologies.

Virtual private networks (VPNs)

VPNs enable users to be part of a local area network (LAN) while they are physically located remotely. A 'virtual' tunnel is created across the public network (the internet). VPNs do not use the cloud, as the servers they connect to are physical. Instead, they provide access remotely through an internet connection.

There are many providers of VPNs offering secure, unlimited bandwidth, a few of which are listed here:

- ExpressVPN
- IPVanish
- VyprVPN
- CentreStack.

VPN systems enable users to become part of a remote network that tunnels over a public network.

Link

To find out how to set up a VPN to access your office files remotely, visit www.sumac.com.

VPNs only work if the individual's device is recognised as operating online. If your device defaults to working offline when using it remotely, then until the settings are configured to recognise your online status, you will only view the files made available to view offline.

VPNs do not enable the same type of collaboration that cloud computing does. However, they do make it possible for employees to access all the files that they can access in the office, at home or while on the move.

Remote desktop technologies

Remote desktop technologies enable any authorised individual to access your system remotely. You may have experienced this if you have had problems when using a device, for example a smartphone. The support technician helping you may have asked for access to your phone to check for any faults or misunderstandings in how to operate the device. By accessing your device remotely, they are better able to deal with the problem quickly and satisfactorily. They might also provide remote training on how to resolve the problem or how to use the device.

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Microsoft systems have the built-in Remote Desktop that allows technicians full control, with permission. There are also utilities such as TeamViewer, VNC (virtual network computing) and Chrome Remote Desktop that all allow remote access for free.

Computer repair services and software issues are also commonly dealt with remotely for both personal devices and business PCs. This way of working means that no time is wasted by physically having to take a device in for repair and perhaps sending it away to the manufacturer (which might be for several weeks, as was often the case in the past).

Theory into practice

Ask your tutor if they can demonstrate or ask a technician to demonstrate remote desktop technology to you. You can try out some of the free utilities at home, but make sure that you only give your details to a trusted friend. Alternatively, try asking your mobile phone or other digital device manufacturer if they can assist you with trying out a feature remotely. Of course, check whether there is a charge for this service first.

Tip

If you are a Barclays Bank customer you could try their Digital Eagles IT support programme which uses remote desktop technology to support customers in how to use IT applications.

Theory into practice

If you are unsuccessful with experiencing remote desktop technology through the ways suggested above, try this activity with a peer. Agree upon a small IT problem to resolve, such as the exact procedure for logging on, accessing a file in the user area or connecting to the internet via WiFi. Sit back to back with one of you describing the step-by-step instructions (the navigator role) and the other carrying out those instructions exactly as described (the pilot role). The pilot is not allowed to ask any questions or seek guidance.

Take turns by swapping roles. Reflect on the experiences and discuss what went well, and what could be improved upon. Evaluate the advantages and disadvantages of using remote desktop technology compared to the pilot and navigator technique. Discuss what you have learnt through this experience.

Factors affecting the use and selection of online systems

You started to learn about some of the issue involved when using online systems in the previous sections. In this section, we will look a bit more closely at factors affecting the use and selection of online systems.

Security

Breaches in security can occur when transferring data over an online network as well while stored on a particular online account. Internet websites which do not include 'https:' at the beginning of their **URL** are less secure and should be used with caution. The 's' in 'https:' stands for 'secure'. If you examine the URL of websites, you will see that web addresses which include 'https:' at the beginning display a padlock symbol to show that the site is secure.

The use of a VPN by remote employees puts them 'inside the corporate LAN' so that they have the protection of a company firewall and filtering despite being remotely located. VPN connections are by their nature encrypted and secured, and a number of different protocols are available that offer different degrees of security. Online systems and tools such as VPNs are essential for a business to maintain the integrity and security of their data and ultimately the confidence of their customers.

Key term

URL – stands for uniform resource locator and is the term given to the address of a website.

Tip

Most cloud computing and storage services, including free ones, are likely to be secure websites, but it is worth checking this before you sign up and certainly before you store personal files on such a service. You should also make sure that you understand the privacy policy when you store files on cloud services.

Cost

Although there is a cost involved in using online systems, and this can escalate as you become dependent on the cloud, there are also pay-as-you-go options and short-term contracts, as well as free applications for individual use. Small businesses are attracted by the pay-as-you-go options and often evaluate the benefits of cloud computing as greatly outweighing the costs involved, including the amount they can save on resources alone.

In addition to the costs advertised for servers and cloud applications, there are all the connected costs associated

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with operating 'in the cloud'. A business will need reliable and fast connectivity to support their employees, there are the fees to register your identity on the internet and a domain name such as mybusiness.com. Having mobile workers 'always on' while being mobile brings with it the demand for data plans with sufficient allowance for the expected use; this is often hard to forecast.

Ease of use

Access and availability online systems of almost wherever you are means that both individuals and businesses can function without having to carry around numerous devices or files of paper, which could be lost or damaged.

If a system or service is not easy to use, then users will not use it. Therefore, if you want users, then you must ensure that your system is easy and intuitive no matter what device someone uses to access your service. Web applications are expected to be 'responsive', that is, to adapt the format of their user interface to the device used to access them. This might mean resizing icons and headers for smaller screens or changing the layout from a table to columns to be more appropriate for mobile users.

Features

Making a decision about which online system to choose will depend on the features it offers. Primarily, the security measures in place should be paramount, but also the type and quality of technical support available should be considered, along with the storage capacity. Any additional benefits offered should also be considered, such as low start-up costs, metered services or the ability to scale up and down the level of service you receive.

Connectivity

To access the cloud, you will require internet access and therefore your choice of internet service provider will depend on stability and, of course, availability. Technology is advancing continually and the Government aims for the entire British population to have broadband access by the end of its current administration.

Access to the internet is available through many different technologies, each presenting different qualities that are more suited to different markets. Table 1.1 lists some of the commonly available broadband connections available and the relative speeds.

Link

For more about the Government's broadband access aims visit https://www.gov.uk/government/policies/broadband-investment.

Online communities

It is highly likely that you belong to at least one online community. In this section, you will explore the features of online communities and the implications of their widespread use for organisations and individuals.

Ways of communicating and interacting with online communities

A wide range of digital devices, such as smartphones, gaming consoles and tablets, enable access to online communities.

Social media

Probably the most well-known worldwide social media website is Facebook and the second is Twitter. Despite concerns by many, and frequent media reports about the disadvantages, both of these websites are used by government departments, other public sector agencies, and most private sector organisations, enabling people to network around the worldwide. Other popular social media websites include LinkedIn and Google+. Customers are resorting more and more directly to social media to contact companies due the public 'naming and shaming' that can take place.

Link

For more about social media see *Unit 3: Using Social Media in Business.*

Table 1.1: Available broadband connections and their relative speeds

Connection	Speed	Technology
ADSL	Up to 20Mbps.	Copper telephone cabling.
FTTC	Up to 80Mbps.	Fibre to the local cabinet and copper cabling for the final connection.
FTTP	Up to 330Mbps.	Fibre direct to the premises.
Satellite broadband	1Gbps down. 10Mbps up.	Linked to geostationary satellites. Sometimes uses slower copper lines for the upstream connection.
Mobile broadband	Up to 50Mbps.	Using 3G or 4G technology.

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Link

For information about how to deal with 'scary news about social media', visit http://www.huffingtonpost.com/common-sense-media/.

Several TV documentaries challenge the way we think about the impact of using social media. For more information, visit the BBC website.

Blog, microblog, vlog

Blogs are like online journals, although they are normally for public viewing, and are contributed to and read by millions. There are blogs relating to numerous topics including gossip, hobbies, interests and news articles. Computing and software manufacturers have blogs that provide information on use, research and development, and for responding to customer queries. (Social media is also used by businesses in this way.)

Microblogs are shorter posts than blog posts and therefore take up less storage space, but the primary reason for the popularity of services such as Twitter is the shorter time it takes to follow a microblog due to the nature of the 'snippets' of information posted.

A vlog is a video form of a blog. One such vlogging website is vlog.it, although YouTube also has a partner program for vloggers which also allows users to make money from their vlogs.

Link

For more about the YouTube Partner program visit www.support.google.com.

Theory into practice

You may never have produced a blog, vlog or even a microblog before. Work with a peer to create one. You may have a blog app already installed on your smartphone, such as Apple Podcasts, PocketVideo or Vlog Camera. Other examples of downloadable software include Google+, Ghost and Pamela for Skype, which is free.

Wiki

A wiki is a website or database which is contributed to by a community of users who work together to add content about a particular topic. Wikis can be added to or edited by anyone, meaning the information cannot be assumed as reliable, current or accurate. The most famous wiki of all is Wikipedia which encourages quality control from contributors by providing authentic sources.

Chatrooms

It is likely you have used a chatroom, perhaps as an alternative to a video call on Skype or WhatsApp. Chatrooms enable virtual meetings or social networks to take place, regardless of where individuals or groups are located. Google Hangouts is an example of a virtual meeting environment. Netmums Coffee House is another example that is used, primarily, by mothers to talk about issues relating to bringing up children. Chatrooms, however, are sometimes unfriendly places and there are inherent risks involved in using them.

Instant messaging

There are few individuals in this country who have not used instant messaging. Instant messaging can be over the internet using an instant messaging app such as Facebook Messenger, Skype, WhatsApp, etc. Texting has become a way of life in the way we communicate, whether it is for pleasure or business. For example, some GP surgeries and hospitals use texting to remind patients about appointments. Instant messaging over the internet is usually free, unlike texting which normally costs a few pence. These instant messaging apps allow users to communicate quickly and privately with their friends and family and to also send images and other files. Instant messaging (IM) apps are beginning to take over from short message service (SMS) messaging, due to their immediacy and chat-like presentation.

Podcasts

You may not have produced a podcast yet but it is a very effective means for communicating audio information as an alternative to, or in addition to, text. News articles often provide a podcast alternative which enables access to someone with a visual impairment. Podcasts can be downloaded onto digital devices, such as your smartphone, so that you can listen to it at a more convenient time. Podcast websites include PodOmatic and Podbean. Some podcast websites, such as ipadio, translate the audio file into text which can be printed.

Forums

An online forum is where individuals are invited to participate in a discussion, usually focusing on a topic in which they share a vested interest. Each forum member can contribute by posting their comments and opinions which can be read later. Although interacting online using a forum or other methods, such as messaging and emailing, involves a transaction between each party, none are actually in real time, as is the case with a chatroom. Unlike a chatroom, the posted interactions to a forum can be difficult to order resulting in losing track of the flow of conversations.

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You are likely to have been invited to join a virtual student forum at your place of study so that you can share ideas or ask questions of your peers. A forum can be localised to restrict access to users; therefore your school or college might have a forum as part of their intranet or extranet, perhaps using Moodle. Other forum websites include Yuku and Social Forum.

Link

For more about Moodle, visit https://moodle.org.

Theory into practice

With a peer or in a small group, identify an example of each type of online community and make notes about the purpose, impact and execution in each case.

Compare each one by analysing and evaluating their advantages and disadvantages for both individual and business use.

The implications for individuals of using and accessing online communities

Using and accessing online communities should be undertaken responsibly and can bring significant benefit to users. You will now explore some of the implications.

User experience

- Ease of use – Most online communities are easy to use and are user-friendly. Users are more likely to stick with communities that are easy to use and which enable them to form online friendships easily. Although needing to do anything more than 'one click' is considered a nuisance, it can provide reflecting time before you post something that goes global and cannot be undone.
- Performance – Performance of online communities depends on the internet connection, the server load and its capability. It also depends on how simple and flexible it is to implement and use.
- Availability – Availability of an online community can be restricted (for example, closed user groups such as selected alumni of a college) or extended to widen the community. Users of online communities do not solely engage in social networking but use them for making contact with lost friends or relatives, attracting new business or for getting advice.
- Accessibility – For those individuals who are immobile or at least unable to travel far, online communities provide companionship, information and news updates. Adaptive or assistive technologies enable access to online communities for people who are not able to use a standard keyboard and mouse or keys on smartphones. Alternatives include speech recognition software, electronic pointing devices and sip-and-puff systems.

Link

For more on assistive technologies, visit Microsoft's Accessibility website www.microsoft.com.

Meeting needs

Online communities enable users to extend their social networks, often with a shared interest or to keep in touch from remote locations. However, there are implications of meeting all of those needs, including the inability for:

- every individual to have access to technology or connectivity
- those with extreme difficulties or disabilities to fully interact with websites
- accurate interpretation by speech recognition software of languages and colloquialisms (although research is being undertaken, for example by Microsoft).

Cost

Implementing an online community comes at a cost. Although individuals might have free access to social networking websites, revenue is obtained from businesses that promote their products and services on the website. Otherwise, the online communities could not afford to run the service to users for free. However, this advertising puts temptation in your way and may tempt you to purchase something you cannot afford or do not need. Some users experience a psychological need to feel connected to the community. This results in such users 'needing' better connectivity and spending more and more money on better connections, for example 4G.

Privacy

The openness of the internet and the proliferation of scammers mean that it is potentially a very dangerous place. Identity theft and fraud are commonplace and so being careful with your data and the sites you visit is essential. However, there are some reputable websites, such as Skype and Google, which endeavour to provide a more private and secure service.

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Reflect

What are your experiences of using online communities? Where you encountered issues, how did you resolve them?

Compare your results with those of a peer. What strategies could you suggest to avoid any problems or potential issues in the future?

Security

You can never be absolutely certain that your online communications are secure. You should remain vigilant and be aware of what is posted. Even if *you* are conscientious, there will be others who are less so and unscrupulous individuals who want exploit those who are careless or vulnerable. You also need to consider the consequences of posting inappropriate content online. Potential employees often now look up an individual's online community accounts to see what kind of person they are, and if they do not like what they see, they are not likely to hire you.

Link

For more about how to keep your online communication private, visit www.securityinabox.org.

The implications for organisations of using and accessing online communities

The internet has opened up boundless opportunities for businesses to communicate. Online communities enable them to source suppliers, market and sell products or services, and to expand their operations on a much wider scale than ever before.

Employee and customer experience

Both employees and customers are able to benefit from a very different experience today than even ten years ago and this is largely down to the use of online communities in business.

- Ease of use – This puts a massive amount of pressure on organisations. They need to ensure that their online presence is as user-friendly and 'modern' as their competitors' and this is a never ending battle. Customers can buy clothes, food or search for properties without leaving their homes. Employees are able to work remotely or at flexible times to meet the needs of customers who could be located anywhere around the globe. Online community systems are mostly simple to use for both customers and employees, regardless of any other IT skills they might have.
- Performance – If the internet is down, it can interrupt an interaction at a crucial stage, leaving employees or customers unsure of what to do next. For example, an employee may be drafting an email which requires some refining before sending to a customer, which could have inadvertently been sent during interruptions in performance.
- Availability – Many businesses expect employees to be available outside normal working hours to manage online communities. With customers and individuals being geographically dispersed, online communities enable contact across time zones and consumers expect now that businesses respond quickly day and night so they need to be available through different devices, regardless of location or time. Businesses might, therefore, have to set up shift working patterns for their employees. A business can appear to be available and operating 24/7 without the cost of opening a store. Businesses may employ cheaper offshore labour to handle the quieter overnight periods since responding to emails and social media is anonymous and so location is immaterial.
- Accessibility – As an employee, accessibility to online communities provides opportunities for keeping in touch with colleagues and customers outside normal hours. Although this might seem unreasonable, if you are responsible for an entire sales transaction and a bonus awaits you as a result (such as for an estate agent or stockbroker), you would be very happy to see it through. Businesses that only operate online restrict their services to those customers with access and IT skills. Employers can provide adaptive or assistive technologies for any staff with disabilities in order to facilitate their ability to work and give them equal opportunities.

Customer needs

As life appears to be busier than ever, customers require more flexibility to source and purchase products which can be sent to their home and be easily returned, if necessary. Customers have become much more discerning and therefore businesses are exposed to greater competition, particularly as online businesses are more far-reaching than local shops. Businesses strive to retain their market share by seeking creative ways to make their business a priority website for customers. Customers are able to undertake research and easily make comparisons between products and services.

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Customers now have a huge advantage in the increased availability of the market place with stores being available 24/7 and access to global markets is instant and troublefree over the internet. If you have a customer care department, then there is an expectation that you will be available online and that you will respond and be able to deal with queries instantly at any time of the day or night.

Theory into practice

With a peer or in a small group, devise a questionnaire to survey family and friends about their experiences and preferences when using or accessing online communities, and then analyse and evaluate the results.

Seek out some employers willing to be surveyed to compare the results with the outcomes from individuals (friends and family).

Cost

Although operating online may be cost effective in many ways and expands the range of businesses promoting their products and services, the problem is that competition drives down costs. There is so much choice and availability that businesses have to try to find ways of keeping costs down and productivity up.

Having a social media presence is not without cost for a business. As well as the need to pay staff to respond and update the presence there is the additional cost of boosting the business's prominence in an online community. Facebook provides tools for businesses to promote posts (adverts) and boost their status for a fee. The tools that social media sites provide are incredibly powerful and allow, for example, a business to specifically target teenagers aged 16–19 in a particular geographical area who have shown they have a liking for outdoor activities. The selection of the demographics is very granular so, while not a cheap option for advertising, the chances of suitable returns are high as you are specifically targeting only the audience you require.

Implementation

An online community takes time to implement and delays can occur at each stage of the set-up.

- Timescales – Planning stages can take considerably longer than expected to convert an idea into a series of structured actions, text and images which will successfully link to the data that sits behind the web pages of an online community.
- Testing – During implementation, the online community will be tested. This will be carried out at numerous stages and will involve many different users.

Replacement or integration with current systems

If the online community is replacing one that currently exists, then users will be familiar with the current system and may be reluctant to engage with any change. During the replacement or integration with an existing community there may be a period of downtime and this inactivity can lose users to other communities. If the implementation is a total integration with an existing system, then the period of inactivity or problems encountered by users may be greater than replacement. Reasons for this may include:

- links between the two systems which may have been overlooked need to be changed
- it confuses users more than starting afresh
- it does not sufficiently address or develop the community to expand on its features.

Productivity

A new online community should provide greater productivity by, for example:

- offering more features such as accessibility
- being easier for users to interact with
- meeting user needs, such as links to similar businesses, economic performance, recruitment and training opportunities
- offering greater security
- offering greater activity by increasing popularity among users.

However, additional features might attract greater risk to the security of information. For example, competitors could gain a greater insight into company practices by having access to its employees in chatrooms.

Working practices

- Organisations suffer from loss of employee productivity by users engaging in social networking during working hours, despite policies against such use for personal interest. Some people have lost their jobs over their inappropriate use of social media at work, because they have overlooked the fact that posts, such as those on Twitter, are visible to everyone including their boss.

Reflect

Have you ever used social media when you should have been participating in something else, perhaps in a lesson? How did you catch up with what you missed? If you relied on a friend to fill in the gaps, consider the time taken to do so, which was unproductive. Were you caught by your teacher? What were the consequences in terms of punishment but also in the time you needed to carry out the work you should have completed?

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Security

Security is always going to remain a risk no matter how sophisticated an IT system is. Reputable online communities have security policies regarding their use for the safety of their users. However, unless businesses ensure that their staff are fully aware of and understand the policy (which should be monitored for user compliance), breaches of security can occur very easily and without intention.

Link

You can find a template social media security policy at www.biba.org.uk.

Reported trends in breaches of data security in 2013 stated that two-thirds of instances were as a result of human error and system glitches, with hacking being responsible for the remaining third.

Link

For more about trends in breaches of data security, visit www.symantec.com.

Case study

Gaming is not always fair play

In April 2011, Sony's PlayStation network was interrupted following a major breach in security. Users of Sony's PlayStation and Music on Demand Service learnt that the personal information of possibly as many as 77 million user accounts had been infiltrated (hacked). The data at risk included:

- user accounts
- passwords
- potentially 10 million credit card details
- names, postal and email addresses and birth dates.

The attack was identified as originating from an application server on Sony's network, originally disguised as a purchase and therefore not spotted by their internal security systems. Sony suffered a blow to its reputation and the risk of losing customers. Users were left without access to their systems until services resumed with security reassurances. Sony incurred more costs by offering extended subscriptions and limited free downloads to its customers by way of an apology.

In late 2014, Sony's customers experienced another security breach which led to employees filing lawsuits against the company for its inability to protect their personal data. Although there were only 47,000 records reportedly involved, the attack was aimed at hurting people by infiltrating their personal data for identity theft rather than their financial data.

Breaches of security can go undetected for long periods of time and it is not until threats are made to users or there are obvious signs of malfunction that the attack is revealed. The sources of attacks are difficult to identify with some being instigated by the organisation itself. One reported way was 'by infiltrating trusted business partners and stealing legitimate credentials for accessing the victims' networks. Once inside, they moved from machine to machine until they reached the subnets containing point-of-sale machines, which they infected with scrapers to steal card numbers and expiration dates'.

Check your knowledge

1. Identify at least three different types of online community which are vulnerable to security breaches of personal data.
2. Explain what was unusual about the second security breach compared with the first example given.
3. Describe the implications for organisations, customers and employees when security breaches occur.
4. Produce a list of ways in which security breaches can occur.

PAUSE POINT How often have you put your personal data at risk?

Hint Produce a list of online communities and networks that you belong to and complete it by adding ways in which you could reduce your risks.

Extend Describe or draw a procedure for using online communities safely and responsibly.

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Assessment practice 1.2

A01 A02 A03

In the heart of rural England, Mollie developed her love of baking, and especially making preserves, into a small cottage industry making and selling jams and chutneys to the local community. As demand for delicious, tasty bottled preserves made from locally grown produce grew, she found herself expanding her business and attending county fairs and specialist markets.

Mollie runs her business from home, using her large kitchen and range cooker to produce the preserves, the triple garage for storage and distribution and the adjacent purpose-built shed for packaging orders. She has managed her business until now with little IT presence apart from a professionally developed website and, more recently, a smartphone. Business has continued to boom as orders have flooded in through the website and Mollie has taken on extra help to assist with boxing up orders and taking them to the post office for despatch.

However, as the business expands she finds that most of her day is taken up with cooking, she spends weekends at fairs, markets and sourcing local produce and every evening is spent on business administration.This includes:

- responding to website enquiries
- placing orders with suppliers for packaging, jars and bottles
- writing packaging labels
- stocktaking
- updating customer records
- paying bills, issuing invoices and chasing outstanding payments.

Plan

- What is the task? What am I being asked to do?
- How confident do I feel in my own abilities to complete this task? Are there any areas I think I may struggle with?

Do

- I know what it is I'm doing and what I want to achieve.
- I can identify where I've gone wrong and adjust my thinking/ approach to get myself back on course.

Review

- I can explain what the task was and how I approached it.
- I can explain how I would approach the hard elements differently next time (i.e. what I would do differently).

Mollie has a laptop and printer and uses word processing to produce invoices. However, she keeps her account and stock records in a book and all her customer details on an index card system. She knows that there are probably more efficient methods, but has not got the time to do her research into suitable options, nor will her business support any extra hired help. Mollie is keen to introduce more automation to the business and is seeking your advice and guidance on what options are open to her. She is willing to invest in a new system or additional equipment to work with her existing IT equipment, which is fairly new. Naturally, Mollie wants to ensure that whatever choices she makes are cost effective and will enable her to spend more time growing the business and less time on administration. She has set aside a budget of £5,000, but is hoping to spend less than that. Your task is to:

- identify the opportunities for automation which will enable Mollie's business to run more efficiently
- produce a list of recommendations
- explain the advantages and disadvantages of the options you provide
- describe the benefits to Mollie's business operations of the options
- calculate the potential costs associated with the options suggested.

As Mollie is an entrepreneur and always looking for ways to grow the business, she will respond to innovative ideas which are presented creatively. She has asked if you would also present your ideas as drawings to demonstrate how they might work in the context of her business.

PAUSE POINT How do you ensure that you remain objective and advise Mollie on what is best in her situation and not be seduced by the budget?

Hint Explore how other small business owners use IT systems to run their operations. Search local directories for contacts – maybe you have a friend or relative who runs a small business or knows someone who does.

Extend What recommendations would you make to Mollie for developing a strategy for the use of IT in an expanding business over the next two years?

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D Protecting data and information

You have started to learn about the implications of using IT networks and online communities, and in this section you will learn more about the issues and implications of storing and transmitting information in digital form.

Threats to data, information and systems

In this section, you will explore the implications of accidental and malicious threats to the security and integrity of data held in, and used by, IT systems.

The characteristics of threats to data

There are a number of characteristic types of threats to data that you will look at in this section. First, consider these extremely common ways in which you, or any individual, may put business and personal data at risk. Anyone can put data at risk by:

- using obvious passwords such as your favourite pet, place or date of birth
- disclosing passwords with other users
- leaving devices open to other users, such as not locking a PC when going to the toilet or not locking a mobile phone
- using the same login details for multiple website accounts
- posting information globally without thinking first as to whether it is sensible to do so
- using personal devices for business operations.

Reflect

We are all guilty of some of these ways of putting data at risk. Consider which ones apply to you. Think about ways in which you could avoid putting data at risk in these ways in the future.

Viruses and other malware

You may have experienced a virus on your PC or smartphone. When normal performance is interrupted, suspicions about a virus or other **malware** are raised.

Key term

Malware – short for malicious software, is software created to steal data by gaining access to an IT system without the user's consent.

A virus is a form of malware. It is software designed to harm your IT system, not just access it for unlawful purposes. Viruses can be passed from one device to another, most commonly by devices such as USB sticks, through downloading software or via files from the internet. A virus can corrupt files and compromise the data.

Link

Find out more about threats to data security at http://ict4u.net.

Early signs that you may have malware in your IT system include annoying behaviour such as applications crashing frequently or the cursor behaving strangely.

Ransomware is a form of virus that attempts to hold companies to ransom by encrypting their data and then demanding a large sum of money to release the data. Even law enforcement can fall for these attacks. For example, in 2015 a number of US police departments suffered attacks and, despite security experts working to assist, they ended up paying the ransom demand to regain access to their systems. In February 2016, Lincolnshire council suffered an attack in which they were unable to access 300 of their machines.

Hackers

Hacker is the term used for anyone who attempts to access an IT system without permission of the owner/user. Hackers are not just groups or individuals who infiltrate secret data or perform identity theft – there is a more ethical side of hacking. Ethical hackers are employed by businesses to test out their defences and try to gain unauthorised access to systems with a view to then repairing the vulnerability to prevent real hackers gaining access intending to do harm.

Phishing

To phish is to attempt to fraudulently gain information by unlawfully making claims via phone or email that the user should share personal data or financial details. Examples of frequent phishing attacks are those pretending to be from banks, including HSBC and Santander, and also from PayPal and MSN.

Research

Explore services that enable you to restrict nuisance calls and unsolicited emails or postal mail.

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Accidental damage

It is very easy to accidentally lose data or at least think that you have. While applications such as Microsoft Office applications issue reminders to users to save files before closing, if the whole system crashes or there is a power cut before a file is saved, it could result in a loss of data (and waste of hard work and effort). Sometimes we think that we have lost a file when we have filed it incorrectly or saved it under an irrelevant name. Although software alerts us to think before deleting a file, if we are hurried or distracted, it is easy to overlook this. It is also easy to save over a file without thinking, which will permanently overwrite the previous file.

Tip

It is important to regularly save your work as well as ensuring that autosave functions are set up in applications that have that feature.

The impact of threats to data, information and systems on individuals

Users experience stress and time being wasted to varying degrees when threats to data occur. Some of these, such as phishing threats, can cause unnecessary anguish, especially to those users who are unaware of the source of these malicious emails and unwittingly share sensitive data.

If your personal device develops a virus, it will prevent or compromise the performance you expect from that device. The system might need to be taken to an expert to fix, leaving you without alternative means to work, potentially exposing your data to even greater risk. You may need to replace your device with a new one if it is deemed irreparable or too costly to repair.

Nowadays, photos are usually stored in digital image files rather than photo ablums. The impact of this data becoming corrupted is often immeasurable to an individual: a lifetime of irreplaceable memories can be wiped out by a simple disk failure. Backup solutions are becoming just as important for individuals as they are to businesses as our lives transition to the digital world.

Research

Explore the options available for insuring your devices against security threats. Compare these with strategies that you can deploy for protecting your devices and data to avoid potentially unnecessary and costly insurance.

Link

For guidance on suitable strategies to protect against data threats, visit:

www.computerweekly.com

www.computerworld.com

www.cisco.com.

The impact of threats to data, information and systems on organisations

When threats occur in organisations, it can impact on all users and the productivity of the business. Just as in the example of Sony's 2014 experience, businesses can face claims for damages from employees or customers and it also can also result in loss of business. Even the smallest breach of data, regardless of its sensitivity, can be incredibly damaging to a business. Public confidence in any system is on a fragile balance and, once this is upset, it can take a great deal of time and money to restore confidence.

If your site is 'down', even just for maintenance, the public perception is that you are unreliable as a business, irrespective of whether or not this is actually the case!

Research

What other examples can you find of businesses exposed to data threats which impacted on the company's reputation? Share your findings with a peer or in a small group.

Protecting data

Having explored some of the threats and implications, you will now learn about some of the features, uses and implications of systems and procedures that are used to protect the data of individuals and organisations.

Processes and implications of techniques for protecting data and systems

Organisations have, or should have, processes in place for protecting data and systems. However, unless these are comprehensive, kept up to date and the policies are followed by all users at all times, the threats to data remain. Some simple processes and techniques for protecting data and systems include the following.

File permissions

Access to files can be restricted through the use of password protection or by setting the file as a read-only

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file, which prevents inadvertent editing, when sharing with colleagues who do not need to edit it.

Reflect

What reasons can you suggest for needing to create read-only files? How might you restrict access to a file?

Access levels

Giving users access to only those systems or applications that they need to fulfil their roles, and restricting the level of access they have, protects data because fewer people are able to put it at risk. For example, limiting permission to filter and query in a database, or making it so that permission is required to add records, will limit the number of people who can change or delete data accidentally.

Link

For more about database access levels see *Unit 2: Creating Systems to Manage Information*.

Backup and recovery procedures

Everyone should back up their data files regularly, regardless of the degree of usage. Most organisations will have a formal procedure which routinely backs up data on a very frequent basis. They may undertake incremental backups which only back up those files which have been amended since the previous backup. A full backup might be undertaken monthly, depending on the size of the organisation and the amount of data produced. Backups do not just back up files but also the contents of servers, systems and processes.

Systems often have automatic recovery procedures, such as the ability to undelete a file or recover a file following a premature software or system closure. Organisations should have a formal recovery plan which enables the system to return to a predetermined point from which operation can continue if the system fails. Larger organisations have full disaster recovery plans in place to minimise any disruption as a result of things such as a natural disaster or criminal attack. These plans can sometimes even involve the maintaining of warm backup sites that mirror the primary base of operations. Alternatively, they can have off-site backups and a contract with a disaster recovery company who will get the backups running on a mobile server farm within hours.

Link

Explore some examples of recovery procedures and backup plans. Search for the following articles on the internet:

'Developing Backup and Restore Procedures', https://technet.microsoft.com

'Recover system procedure', www.ibm.com

'HP System Recovery Procedures'.

Passwords

Passwords should be kept secret, regardless of whom you may trust. Think of your passwords like your bank account details or PIN number, which you would not share. Weak passwords can be easily identified and are often repeated by users for different websites and purposes. Strong passwords should have between 12 and 14 characters, and use upper and lower case letters, numerals and symbols.

Link

See The characteristics of threats of data, for more on how not to use passwords.

Physical access control

Leaving your computer or device unattended and unlocked exposes your data to others, whether you are present or not. Locking, shutting down or removing the device protects your data from immediate access by a passer-by. Not logging out properly or fully from your system or an online account leaves your data exposed to potential risk. Organisations have restricted physical access to data centres and cabling for their computer systems.

Digital certificates

Digital certificates are unique codes which are assigned to you by a business to verify your identity when performing a transaction, such as a money transfer or requesting a bank statement. It is sometimes called a public key certificate and works in a similar way to a passport. Digital certificates are also issued by certificate authorities to facilitate SSL (https).

Protocols

Protocols are the agreement between devices regarding how a communication might take place. There are a range of protocols that are concerned with security. Secure data transfer relies on some form of encryption – for websites this is SSL or TLS which uses public key cryptography.

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There are also human operating protocols, such as policies for using equipment or creating passwords, but the difficulty is in remembering numerous ones for different systems, devices and actions. Common password rules include using a mix of letters, numbers and symbols in upper and lower case. Additional passwords are used by websites such as those performing financial transactions. It is not unusual for some users to store their passwords on their computer in a file or diary. Another option is to use a password vault, e.g. LastPass or 1Password.

Reflect

How secure are your user areas? What strategies do you use to remember your login details or various passwords? How could you improve the security of your data?

The features, characteristics and implications of using antivirus software to protect data

There are numerous organisations developing antivirus software in an attempt to keep our data and systems secure, including:

- Kaspersky
- McAfee
- AVG
- Symantec (Norton).

Antivirus software is designed to search out and stop attempts to corrupt your IT system or files using viruses or any malware. Different antivirus software approach this in different ways, but common features include:

- real-time scanning to check files as they are saved or opened
- deep or full scans used periodically to check an entire storage device
- heuristic analysis to look for 'virus-like' activity as well as known viruses
- virus definition databases.

However, the more you expose your system to a wider network, the greater risk to your system. For example, your IT system and data are more exposed when you use cloud computing, but many people do use it because of the benefits.

Antivirus software manufacturers provide similar, yet different, types of protection, including seeking out updates to antivirus software via the cloud. Antivirus software needs to be working continually to check for threats and should be installed before commencing any computing operations. However, the constant scanning and checking for threats required by antivirus software increases the load on a system, including the CPU, memory and disk activity.

Theory into practice

Compare different types of antivirus software in terms of their features and what they cost. Compare those that you can download for free with those for which you pay a subscription. Evaluate which are most suitable to meet personal and business needs.

Research

With a peer or in a small group, share your experiences of antivirus software. Explore the advantages and disadvantages of at least six different types of antivirus software according to their features, prices, versatility and impact on other software and processes.

The features, characteristics and implications of using firewalls to protect data

Firewalls

A firewall performs a different function to antivirus software. It monitors the network traffic and decides whether or not to let the traffic in or out. It can protect the IT system from unauthorised access and can be both hardware and software. Hardware firewalls are usually part of the **router** whereas software firewalls are applications. Software firewalls, the likely choice for individuals, must be stored locally on the device, not on a network. They can be manipulated by users who may reduce the restrictions on traffic, or be turned on and off to speed up performance or allow access to prohibited websites. Like any software, updates should be installed whenever they become available.

Firewalls can use a variety of methods to protect a network, from the basic port blocking where the firewall simply refuses incoming access to the network to the more advanced stateful packet inspection (SPI) where the firewall uses active connection data to look at where packets are from and to to decide whether the incoming data is legitimate and connected to an active connection. Firewall configuration is a skilled task that can easily have a major performance impact on a network if not done correctly.

Key term

Router – an electronic device that enables data to be transmitted between networks.

Reflect

What immediate actions will you take to protect your data from risk of loss or damage?

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The features, applications and implications of encryption methods used to protect data

Stored data

Methods for encrypting data which you intend to store include using specialist software which can:

- create hashes, which are fixed-length signatures for the text
- use a key to crypt and decrypt messages (known as private key cryptography); therefore anyone with the key can access the contents of the message
- using a public key to allow one-way encryption of data which is decrypted using a matching secret private key.

Link

For more about data encryption methods visit http://datashieldcorp.com.

The implications of using encryption methods include:

- if the code or key is forgotten, then the data may never be decrypted
- the way in which the key is shared with those entitled to access the data can result in other risks to security.

Data during transmission

Data is often assumed to be secure when it is not. For example, an email is sent in plain text between servers and can be read by anyone along the way. The encryption of data in transit is essential when communicating information which may be confidential or sensitive. As you have already seen, web pages make excellent use of encryption when using https (SSL or TLS). It might also be desirable to encrypt all network traffic to ensure security. Pretty good privacy (PGP) can be used to encrypt the contents of emails which are then sent in plain text, but would be unreadable to any unauthorised access without the appropriate decryption key.

Discussion

In your group, discuss the following. Who watches the watchers? Should governments have access to private keys and therefore the means to decrypt secret data?

Reflect

Have you ever used any form of encryption method? What did you use and how did it work? Try using other methods. What have you learnt from the experience that would help you when advising others?

If a break occurs during the transmission of encrypted data, the data may continue being decrypted and expose itself to threats. For example, when performing a bank transaction, data is encrypted and decrypted to protect the holder of the account. If that holder takes a break or becomes distracted, the data is accessible to others during this period. It is advisable therefore to avoid disruptions and breaks in such sessions and, especially, to avoid using public access devices for such transactions.

The role of current legislation in protecting data and IT systems from attack and misuse

Chief Information Security Officer of Honeycomb Connect Banking Information Technology said in a webcast to his members in 2006, 'Other than everyone who works for us and everyone who doesn't work for us, we have no one to fear.' That is, everyone could be a potential threat, intentionally or unintentionally. Legislation is necessary to provide legal remedies for breaches; it acts as a deterrent and it sets clear acceptable limits that describe what unauthorised access actually is (see Table 1.2 for information about current legislation)

Link

For more about Honeycomb Connect visit www.honeycombconnect.com.

Therefore, legislation such as the Computer Misuse Act of 1990, which legislates against computer crime, is necessary to protect data and IT systems from attack by:

- hackers
- fraud and theft
- copyright infringement
- abuse, for example:
  - cyber bullying
  - trolling (deliberately trying to cause arguments or offence)
  - child pornography
  - harassment.

Link

For more about legislation, such as the Computer Misuse Act of 1990, see Legal, moral and ethical issues.

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Table 1.2: Current legislation protecting IT systems

Legislation	What does it protect?	What are the consequences for breaching?
Data Protection Act 1998	The storage and processing of personal data. The right to accurate storage and proportional use.	Fines of up to £500,000.
Computer Misuse Act 1990	Protects IT systems against: • unauthorised access • unauthorised access with intent to commit crime • unauthorised modification of material.	 • Two years in prison. • Five years in prison. • Ten years in prison.
Freedom of Information Act 2000	Places a legal obligation on public bodies to release information in response to requests from the public.	• No penalties.

Reflect

Do you know, or think you know, of anyone who has been a victim of some form of cyber bullying? What would you do or did you do?

Discuss with a peer what steps you should take if you were concerned about cyber bullying that is happening to yourself or someone you know.

Research

Try searching for case studies about cyber bullying, such as the 2014 Channel 4 drama Cyber Bully, starring Maisie Williams, or government guidance at www.gov.uk.

The impact on individuals and organisations of legislation designed to protect data and IT systems

Government legislation exists to protect data. This is known as the Data Protection Act of 1998. As with all legislation, it is frequently monitored and reviewed for its relevancy and to accommodate changes which impact on its promises.

Link

For more about the Data Protection Act of 1998, visit http://www.legislation.gov.uk/ and http://ico.org.uk/.

The Data Protection Act requires that personal data is not shared without the permission of the individual it relates to and also provides individuals with permission to ask for information held about them by organisations. There are eight principles with which all records must comply:

- fairly and lawfully processed
- processed for limited purposes
- adequate, relevant and not excessive
- accurate and up to date
- not kept for longer than is necessary
- processed in line with your rights
- secure
- not transferred to other countries without adequate protection.

The act entitles everyone to read their own medical records and the records held about you by your place of study. There are certain exceptions to this, and a charge may be levied. The people responsible for inputting the data must be aware of any consequences arising from sharing that data.

Information about registered companies is also accessible to anyone under the Companies Act of 2006. Therefore businesses and individuals can seek trading information about other businesses, providing they are registered with Companies House.

Public bodies have been heavily affected by the introduction of the Freedom of Information Act which means that they are required by law to release information to the public if asked for it. The intention of this Act was to provide much greater transparency to government bodies. It revealed some surprising data which has led to legislative change, for example the MPs' expenses issues of recent times.

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Link

For more about legislation designed to protect data and IT systems, see Legal, moral and ethical issues .

The purpose, role and impact, on individuals and organisations, of codes of practice for the protection of data produced by the Information Commissioner's Office (UK) and professional bodies

The Information Commissioner's Office (ICO) is the UK's independent body intended to 'uphold information rights in the public interest, promoting openness by public bodies and data privacy for individuals'.

For individuals, the ICO provides assistance in accessing your data, stopping nuisance telephone calls and raising concerns about organisations. As well as performing a monitoring and reporting role, it provides individuals with the opportunity to update their records, for example information contained within the electoral register.

Link

For more about the Information Commissioner's Office (ICO), visit https://ico.org.uk/.

Professional bodies enforce the legislation relating to their sector of expertise by prescribing a code of conduct or practice. Examples of such professional bodies include:

- Association of Chartered Certified Accountants
- Law Society
- British Medical Association (BMA).

For organisations, the ICO also provides guidance and interpretation of legislation such as data protection. It provides a filter for legislation which must be complied with according to the business sector. For example, small businesses can learn about data protection and use the training leaflets provided to train their employees. Those in marketing roles can find guidance about what affects the way they operate, and there are rules about maintaining customer databases or environmental regulations.

Organisations may be required to register as a data controller with the ICO if they process personal information. For example, if your local leisure centre sends you a text to remind you of an appointment, it should also be registered with the ICO under the Privacy and Electronic Communications guidance.

Professional bodies, such as the Crown Prosecution Service, become involved when reported breaches lead to prosecution.

Link

For more about the professional code of practice laid down by the BMA, visit www.gmc-uk.org.

Some of the other professional bodies include:

- General Teaching Council
- General Medical Council
- Care Quality Commission.

Each of these professional bodies also prescribes a code of practice which must be followed, such as that laid down by the BMA and the Hippocratic Oath for those in the medical profession.

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Assessment practice 1.3

A03 A04

A small business owner, Serena, has asked for your advice about protecting the data on her system. She runs an engineering business that produces steel products to customer specifications, some of which are uniquely designed sculptures. She is concerned about her customer records, especially the unique designs and their copyright. She has heard that there is legislation about protecting such information but does not know what it entails or how to implement it.

The business currently operates on a single computer used by the administrator/receptionist but, as the business grows, she wants to be prepared for taking on at least two new members of staff, one for technical drawing and another for managing all customer information and accounting procedures. Serena is interested in what systems and software she should budget for and how to secure the data. She has arranged for additional funding from the bank and has £15,000 set aside for the next stage, although knows that she may have to spend more in the future. She has asked you to:

- discuss the options available to her that best suit the short-term business plan
- demonstrate how they will provide her with peace of mind and fulfil any legislative requirements
- calculate software and hardware costs
- analyse at least two different options for suitability
- write an evaluation of your findings and make recommendations for her to consider.

Plan

- I shall prioritise the tasks and prepare a checklist of things to do.
- I shall identify a range of resources to help me.
- I will keep a detailed list of all my sources which anyone can locate.
- I will allow for some buffer time as a contingency.

Do

- I have structured my schedule to ensure that I cover all the criteria.
- I am double checking my calculations and finding alternative costings.
- I am putting the customer needs first beyond my own preferences.
- I am providing alternatives for the technical language and terminology .

Review

- I am pleased with the outcome and I do not think I could improve it at this stage.
- I know what I need to learn to expand my current knowledge.
- I can recognise what progress I have made from undertaking this activity.

PAUSE POINT How could you have presented the outcomes differently if the customer was from a different sector or had more technical knowledge?

Hint Try putting yourself in the position of a business owner and viewing the outcomes through 'different eyes'.

Extend Find yourself a local business mentor who can give you constructive feedback about your suggestions.

Theory into practice

What strategies for safe online working have you learnt that you could recommend to your workplace or where you study?

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E Impact of IT systems

In this section, you will be learning about the uses, issues and implications of IT systems and their impact on individuals and organisations.

Online services

Firstly, we shall explore how the features of online services are used to meet the needs of individuals and organisations. Since the year 2000, global internet usage has increased from 360 million to more than three and a quarter billion, an increase exceeding 800 per cent. The largest usage is in Asia, with more than 1.5 billion users, while the greatest proportion of a population using the internet is the USA, with almost three-quarters of the population using online services.

The internet provides services for almost everything we want, from ordering takeaway meals to finding our long lost relatives and ancestors. However, the more we expose ourselves and our personal data by using online services, the greater the risk of fraud.

Link

For more about online services, see *Unit 3: Using Social Media for Business*.

The features and implications of using online services

In this section, you will look at the features and implications of using online services to support a selection of key industry sectors and aspects of everyday life.

Retail

We can purchase almost anything we want over the internet. While this means that we can shop at a time and place to suit us and we have an immeasurable amount of choice, it also means that we have access to products or services which are not regulated by government standards, such as unlicensed medication and pirated products. We are also exposed to the risk of any payment being taken without goods being provided or receiving unregulated products.

Financial services

Financial services include advice and services for mortgages, investments, banking, debt and loans. The UK's financial services are regulated by the FCA (Financial Conduct Authority) and PRA (Prudential Regulation Authority) but, because we have global access online, not all of the services you use can be confirmed as being authentic or reliable. We also have relative newcomers to the financial marketplace with incredibly popular providers such as PayPal now becoming a dominant force on the internet.

Link

For more about the FCA, visit www.fca.org.uk.

Education and training

You may have searched for courses, career guidance and training providers prior to enrolling at your place of study. The way in which we are taught and study has also been influenced by online services. We are now able to research online and use this method more than using reference books (although these are still useful) and we can learn from digital activities and virtual teachers. Academic institutions across the world are getting involved with launching MOOCs, as discussed earlier in this chapter, which can access new audiences and bring education to the masses. Unfortunately, there are also many examples of where unscrupulous training organisations and rogue universities issue certificates which are unregulated.

Link

For more about the threat of rogue certificate authorities, visit www.jurinnov.com.

Tip

Expand your research by using Google Scholar to access research journals and articles.

News and information

It is suggested that we are bombarded online with more information every day than the equivalent of the content of almost 200 newspapers. Due to the ease of availability of online services and the range of technology enabling us to access those services, we churn out enormous amounts of data daily, far exceeding the amount we produced just 20 years ago. Although we have the opportunity to be better informed, we are also able to produce more meaningless information, which can cause disruption to work patterns and periods of concentration. News is now being broadcast in real time thanks to the global nature of technology and communication networks. For

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example, when the 9/11 attacks occurred in 2001, almost immediately footage was being broadcast around the world with hundreds of camera angles. News gets 'out there' so quickly that it is harder now for authorities to delay news to help investigations. Photographs of incidents such as the Shoreham Air disaster in 2015 hit the internet almost instantly, which meant that authorities really had a race against time to inform families of any victims before they found out through the media.

Entertainment and leisure

You may have subscribed to films directly from your television or by using an app on your mobile device. We can watch our favourite TV programmes whenever we want rather than missing them or having to record them using other devices. Having the ability to do so can also dominate our lives because this can occupy more waking hours than when TV was only available for a restricted number of hours a day. Another implication of this is that programmes unsuitable for children and vulnerable adults are now available without a time constraint (known as the watershed). However, it is also possible to put safety locks on devices so that a password is required to access certain channels or to turn on the TV. The bringing into the home of services such as online casinos also brings with it problems. No longer do people who wish to gamble have to go out and visit the casino – they can play (and potentially lose thousands of pounds) without ever leaving their armchair; so the impact of increased access to leisure services online is not entirely positive.

Productivity

The services available to employees can result in happier, more productive employees; using tools such as remote working, flexible working and collaborative cloud workspaces allows employees to access and use their productivity at any time and wherever they may be. However, this could be seen as intrusive into one's personal life as employees may be expected to check and respond to work communications outside of work time.

On the other hand, the generation of large amounts of data and information online can severely interrupt our work patterns. That is, we can become easily distracted by text messaging, emails and social media rather than focusing on our work and other priorities.

Some organisations confiscate mobile devices and monitor staff internet usage, especially emails and social media. Many businesses have policies which have led to employees being disciplined or sacked due to the loss of productivity resulting from their inappropriate use of the internet.

Link

The suggested cost to businesses of staff using online services at work is in the billions of pounds. For more on this story, visit www.hubpages.com.

Theory into practice

What is the policy regarding using the internet for staff and for students at the place where you study?. Would you make any improvements to it and, if so, how would you go about trying to influence the management into making those changes?

Booking systems

Receiving paper tickets as evidence for travel will soon be a thing of the past on all means of public transport. Online services provide us with the ability to search out competitive fares, book travel in advance or at the last minute and receive an e-ticket as proof of purchase. There is always a security risk when relying on online services as personal data is collected during transactions. In theory, if someone were to hack this data they might be able to find out your address and would know that you will be away from your residence for a holiday and so could commit burglary.

The method of opting out of further contact from online services is often made difficult to locate on websites and sometimes requests made by websites to use your data for marketing purposes can result in continuing contact, which is a considerable nuisance.

Reflect

What is your experience with nuisance online marketing? What have you done about it?

The uses, impact and implications of different online services

In this section, you will look at the uses, impact and implications for individuals and organisations of different online services.

Transactional data

Transactional data includes the information that is recorded every time a transaction is made, whether it is a personal or business-related financial transaction. Businesses collect data from transactions which can be used to inform them of your preferences, for example websites you have searched, including those you have not used in a while. Therefore businesses generate masses of

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data that can be analysed. They monitor browsing patterns through websites and buying patterns using tools such as loyalty cards and they can adjust their promotions to meet the market demands. The prevalence of online systems brings with it the inherent logging and audit trail that benefits all, as it is an indisputable record of what went on.

Targeted marketing

One of the ways in which businesses use transactional data is to target their marketing at likely customers, such as sending them offers to purchase similar products or engage in similar leisure interests. They will offer enticements, such as vouchers towards your next online shop with them.

Less scrupulous business practices include examples of companies that collect on behalf of charities targeting individuals with requests for contributions, especially around Christmas time. These begging and phishing emails and phone calls have a considerable negative impact on vulnerable adults, especially the elderly who feel pressured into making contributions or signing up to new services without fully understanding what they are agreeing to.

Another argument is that the quality of advertising is increased. It is more relevant to what you need and becomes almost helpful rather than an annoyance. With this in mind it is essential that companies are competitive as they really do need to compete in a global marketplace.

Reflect

Have you been influenced by targeted marketing or do you know someone who has? What examples can you identify that have led to a positive outcome for the business and what advice would you give to someone to avoid being easily led?

With a peer or in a small group, explore positive forms of targeted marketing that businesses could deploy.

Collaborative working

Online services enable individuals to work together regardless of where they are located. This provides individuals with opportunities to work in extended groups and on larger projects, while businesses can build teams based on individual strengths from a wider group of individuals. This can save businesses time and money.

Collaborative working online also means that two or more individuals can have remote access at the same time to central files which are shared for reading, editing and contributing to, using cloud computing. Levels of authorisation and restrictions need to be in place to avoid any risk to the integrity of the data. Collaborative working relies on internet access and is also at risk from hackers, as is any online activity.

Impact on organisations

Technology has developed so rapidly that it is hard even for those who have been in business for 20 years to recall the impact it has made on the way we operate commercially. When electronic word processors began to arrive in offices in the mid- to late 1980s, before PCs were widely available, these were seen as revolutionary in the way they could store short phrases and enable limited word processing before printing onto paper. These machines quickly replaced the old typewriters and the need for bottles of correction fluid.

By the mid-1990s, desktop computers (PCs) were a familiar sight in offices although the internet was still rarely available. Businesses were becoming automated with the use of office software suites and accounting software. Individuals and businesses alike were able to produce their own professional-looking documents and notices using desktop publishing software. Retailers moved from manual or basic electric cash registers to using digital tills by the end of the twentieth century, although self-service checkouts were not introduced in the UK until 2010, by Tesco.

In the mid-1990s when mobile phones were first being used by businesses, they were generally car phones with a handset which could be removed for safety. Mobile phones as we know them today were not available and were not only heavy and cumbersome pieces of equipment but also extremely expensive to buy and operate. Mobile phone service providers were distinguishable by the phone number issued by the network and the signal was often unreliable.

Fast-forwarding ahead to the current day, the developments in technology have been described as beyond imagination and are even said to be running our lives rather than the other way round. It is probably impossible to spend a day in the modern world without using or observing someone using technology. Developments are such that organisations expect us to manage our lives using technology. Examples include:

- online shopping, including buying food, for which we no longer need to step outside our homes
- social media websites for support with using unfamiliar items that we may have purchased
- borrowing money, which previously would require an interview with a bank manager for a large purchase

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- organising travel and accommodation
- medical consultations over the telephone
- internet dating and matching services.

The features and implications of IT systems used by organisations for various processes

As the internet has become a feature of almost every business operation, the impact has possibly been most obviously felt through internet shopping. It seems hard to believe that online shopping has only been around for only a couple of decades. It has multiplied in its popularity year on year with shoppers spending twice as much in 2013 as ten years ago. Online sales were already exceeding £50 billion by 2012. Reports suggested that, by 2016, one-fifth of all high street stores would close due to lack of demand, but this has not proved to be true.

Reports also suggest that the reasons for the growth in online shopping is not only access to the internet, mobile devices and familiarity with using technology, but is particularly due to confidence in making purchases online and less concern over the security and safety of our financial details.

Research

Learn about the ways in which technology is used by organisations such as the Samaritans (at www.samaritans.org), how governments are using social media for sharing information (https://govtrequests.facebook.com/) and why chat lines can benefit business (www.inc.com).

Reflect

How much do you and your family rely on internet shopping? How would you manage without it and how would this impact on the way you manage your life?

A major benefit to businesses from IT systems, and networking in particular, is the opportunity to source suppliers and materials and promote their businesses across a wider area. This is known as e-commerce.

Business operations have been automated and are now more reliable, although this does not necessarily replace the need to understand the basic principles of manual processes, such as accounting and stocktaking. You will now explore some of the automated processes relied upon in business today.

Stock control

Controlling stock has become more efficient and effective since the introduction of online systems whereby bar codes automatically populate databases and show stock levels. Stocktaking is simplified and levels can be monitored digitally so that retailers are less likely to run out of supplies. In the case of large businesses such as supermarkets, their stock levels are monitored centrally and supplies are ordered from central sources. Sometimes, RFID is used to automatically track stock from factory through distribution to the consumer. This allows a business to instantly inform a consumer about the status of their order.

While this type of stock control system may reduce staff numbers formerly required for placing orders, it also results in staff not knowing what stock is likely to be received until it arrives.

Data logging

A data logger is a digital device which measures, monitors and records information in real time such as a CCTV camera, weather station or carbon monoxide sensor. As these become more sophisticated, and as many rely on wireless connection rather than standalone systems which interface with computers, reports can be interrupted if the wireless connection is broken. Therefore alternative means such as a battery backup are required for continuity, for example in burglar alarms. They allow for more responsive ordering, for example a filling station might use data loggers that report the amount of fuel in the fuel tanks automatically and order replacement fuel when a preset level is reached, so removing the possibility for this to be overlooked by staff.

Data analysis

The data gathered in a data logger is analysed to monitor performance, for example those used in motor racing and horse racing. Analysis can provide information about vehicle performance or photo finishes, although such systems are also open to abuse through the manipulation of data. Your PC or smartphone also logs performance data and analysis can provide information of activity. This information can also be hacked into remotely if security measures are not in place.

A good example of data analysis is that of a supermarket that uses loyalty schemes to track shopping habits which can then be analysed extensively. The term 'big data' has arisen as the handling and 'mining' of these vast data stores. For example, a retail business might use this data to forecast when consumers begin purchasing their holiday essentials – this way they can more accurately order the

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stock to be available at the time when people want to purchase these goods.

General office tasks

General office tasks include administrative operations such as communicating by letter or email, producing invoices, which can be automatically generated from transactions, and producing company accounts using specialist accounting software. General office tasks are performed by a wider range of employees than in former times where dedicated personnel, such as secretaries, were employed to carry out administrative tasks. This is because the systems used to carry out administrative tasks are easier to use and the general population has more IT skills. Difficulties arise where individuals become overloaded by administration, which impacts on the time they have to perform their craft or trade, such as doctors, nurses and teachers. Administration can get forgotten about. Smaller businesses, in particular, can lose money by forgetting to issue invoices or by not following up on quotations and orders.

Research

With a peer or in a small group, identify a small local business and explore their operations to identify how and where they use IT systems. What implications are they likely to face and how do IT systems benefit their daily practices?

Tip

Why not visit a local employer who is willing to show you how they use IT in their daily practice? Perhaps a local charity shop will assist you or the office of your local MP or a nearby school.

Creative tasks

Technology enables a plethora of options for being creative. Even untrained individuals can create film shows from static images by adding transitions, subtitles and sound using software which is often free. Designers, such as those in car manufacture, or architects can produce drawings using software such as **CAD** to create 3D imagery and combine **QR codes** to produce virtual rooms which enable clients to better visualise concepts in their own settings.

The sophistication of 3D and 4D software enables the production of professional-looking drawings which could mislead individuals who may overlook the credentials of the company and their ability to actually implement the construction to the specifications of the drawings, because they are being seduced by the quality of the graphics.

Key terms

CAD – computer-aided design software which is used for detailed technical drawings. It is used to help design cars and buildings.

QR codes – quick response codes which provide direct links to, for example, websites or make a payment, using a QR code reader app such as Red Laser.

Link

Search on the internet for more information about 3D and 4D software.

Advertising

Technology has revolutionised advertising by providing access to techniques previously used by the trade, such as software that provides easy-to-use templates and through the use of social media and the internet, for example:

- pop-up adverts when surfing the internet
- adverts embedded in social media interactions.

Organisations now have the ability to pinpoint the target audience for any advertising.

Theory into practice

What positive and negative methods of advertising can you describe? Share these with a peer and explain what makes them positive or negative, in your opinion.

The benefits to businesses are that they can advertise more widely and avoid using specialist and costly advertising companies by generating adverts in-house or relying on their websites.

The implications of making advertising simpler and easier for many include other activities such as:

- phishing – an illegal practice and form of social engineering
- **viral** marketing and advertising – where the quirkiness of an advert promotes sharing by the public, which eliminates distribution and display costs.

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Key term

Viral (advertising/marketing) – unsolicited and infectious marketing tactics using social media to attract interest.

Manufacturing

Technology has significantly benefited the manufacturing industry. For example, data from digital drawings can be transferred to automated machines to create precision-produced components such as:

- car parts
- components for buildings
- medical prosthetics.

The implications are that employee numbers are reduced as they are replaced by automated machines. Machines are mostly reliable, accurate and increase productivity by working around the clock and they can produce in larger quantities.

Security

CCTV and burglar alarms are common means of security, and most people use antivirus software to protect their digital devices. Systems such as aircraft flight recorders are far more complex and vital for logging data to establish any breaches in security, especially in extreme cases such as air crashes.

As we become more security conscious, there is a feeling of being constantly under surveillance, for example when shopping. The technology exists to tag more expensive items and the store's CCTV automatically can keep a customer under surveillance while carrying such an item. The introduction of convergent networks means that additional CCTV cameras can be added quickly and easily to the existing network cabling.

The impact and implications for organisations of using IT systems

In this section, you will look at the impact and implications for organisations of using IT systems in terms of the following aspects.

User experience

The way in which businesses operate has changed since the implementation of IT systems, in every sector. Employees spend long periods of time using computers, inputting and generating data and probably less time communicating verbally, for example to resolve problems and plan projects.

- Ease of use – Systems continue to become more intuitive and easy to use.
- Performance – Using technology can be seen to save time, enabling employees to tackle greater workloads and undertake a wider range of tasks.
- Availability – Online systems are readily available, which can have a positive impact on employee performance because they can be more productive. On the other hand, they may be distracted by the easy access they have to social media.
- Accessibility – Not everyone has easy access to IT systems, especially those with specialist needs such as physical disabilities or learning difficulties.

Employee and customer needs

Employees and customers both benefit from businesses that use IT systems. For example, IT systems allow for the immediate allocation of a product or service to a customer, such as seating on a train or aircraft. However, technology can result in loss of personal interaction, through automated services such as customer helplines. Due to data logging and businesses wanting to generate greater productivity, procedures can be set up to monitor time devoted per customer, such as in fast food outlets.

Cost

Businesses benefit from reduction in employee costs by reducing the number of workers required to perform tasks which can now be managed by fewer individuals or machines. However, there is an increase to certain costs, such as those relating to technology for:

- maintenance
- upgrades
- replacement systems
- training and retraining staff.

Implementation

Before technology and the reliance upon IT systems, businesses employed staff who could carry out their duties almost immediately, depending on their skills and knowledge. For example, secretaries and administrators who knew the procedures for their roles and shop assistants who could deal with customer transactions. However, technology can interrupt businesses practices, especially where bespoke systems are implemented, such as specialist **CRM**, **MIS** and **SAP** systems or those for stock control or accounting. These interruptions may be due to the following factors.

- Timescales – Delays in decision making, availability of budget and delivery or installation of new systems.
- Testing – Time to test the new system under different circumstances and conditions.

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- Downtime – The period when the old system is being replaced with the new one can result in no system being available at all (such as the transition experienced by the NHS with loss of or limited access to patient records). Downtime can impact on productivity while staff are being retrained or getting used to a new system, or simply due to employees displaying some resistance to becoming familiar with the changes.

Key terms

CRM – customer relationship management system.

MIS – management information system.

SAP – systems, applications and products is a data processing system.

Replacement or integration with current systems

There are risks associated with replacing systems or integrating changes to existing systems. Both of these methods will interfere with working schedules and contingencies should be considered to mitigate loss of business or revenue. In some businesses, such as those which operate 24 hours every day, finding suitable solutions might involve a decision made upon the time of day, or day of the week, when business is at its slowest and therefore loss to services is the least disruptive. For example, software changes were made to reflect the fare increases across London's public transport system at the start of 2016 on the Bank Holiday. The impact resulted in systems not recognising prepaid travel cards and passengers enjoyed free travel, albeit for a short period of time. Although this occurrence may well have been unexpected, the loss in revenue could still be significant but not as bad as if it were done in rush hour at a busy time of year.

Productivity

Automated services provided by IT systems are recognised as being beneficial to productivity. For example, automation in the manufacturing industry greatly increases the quantity of products which can be produced and reduces rejects due to the accuracy of preprogrammable machines, such as those using computer-aided manufacturing (**CAM**). However, as you have been exploring, the introduction of or changes to IT systems can also interrupt productivity. Introducing multiple computer processes into industry can also impact negatively on productivity, for example if employees are required to operate a series of machines sequentially and lose concentration or become distracted from their routine.

Key term

CAM – computer-aided manufacturing is done by machines that use software to operate tools and machinery for manufacturing, so providing greater precision and accuracy.

Working practices

Normal productivity can be disrupted by even the threat of new systems being implemented and certainly during the period of implementation. Staff can be exposed to changes to their routine and the way they work and even the terminology that is familiar to them. Any changes to working practices, even if they will bring out greater productivity in the long run, may have a negative impact in the short term. The expectation, even if not verbalised, of staff needing to be 'switched on' 24/7 can be stressful. With home working, there are no longer the clear home/work boundaries.

Staff training needs (initial and ongoing)

Any new system usually requires some training to use and the cost and time implications to businesses can be considerable. The difficulty also lies in the skilfulness of those providing the training and the timing of that training. For example, training that is all up-front, that is at the start or before using a new system, is less effective than phased training which enables users to ask questions and pose scenarios to resolve queries they have encountered personally when starting to use a new system, rather than those that might be encountered.

User support

IT systems and those providing networking solutions usually offer user support, such as Microsoft's and Apple's online and telephone support services. However, specialist systems require specialist, dedicated support for that system and, where systems are bespoke, they are more restricted in the type of support available to respond to individual queries and may incur additional costs.

Security

Ensuring that sufficient and adequate security measures are in place while implementing an IT system, before it becomes operational, can have an impact not only on the lead time for users but also on the costs involved, both during set-up and for ongoing maintenance. Whatever measures are implemented, they need to be constantly monitored for their effectiveness. This may require dedicated staff time to check data-logging records and analyse risk levels.

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Using and manipulating data

Having explored some of the benefits and implications of IT systems used by organisations, you will now learn more about the uses, processes and implications for individuals and organisations of accessing and using data and information in digital form.

Sources of data

Source data is often referred to as raw data, which means that it is unrefined and that something has to be done with the data in order for it to become information. There are two types of data sources: primary and secondary.

Primary

Primary data is data that the organisation has collected or produced itself.

Primary data might, for example, be a list of customers' details. This primary data can be input into a CRM in order for a mailshot containing a promotional leaflet to be generated, by merging their names and addresses, or to produce labels for envelopes.

Secondary

Secondary data is data that is 'bought in' or collected by someone else.

Secondary data includes data which is second-hand, as it has already been through some sort of data-handling process. This includes:

- research articles
- government reports
- journalist accounts
- reference materials.

Reflect

What are the main methods you use for getting information? Which do you use least and why?

Theory into practice

Revisit one of your recent assignments or activities from this unit. Explore a wider range of sources of data, which should include, at least, all the examples of secondary data given above and one additional source. Analyse the data and evaluate its usefulness. Consider the impact that your latest findings would have on the outcomes you produced for the assignment or activity. If they differ, why do they and what are the implications? If they do not differ, why not?

What have you learnt by undertaking this activity? What will you do differently in the future?

Judging and ensuring the reliability of data

You cannot assume that everything you hear or read is reliable. One such example is when police investigations dismiss witness accounts which are purely hearsay and where there is no solid evidence to verify the information provided. An internet wiki is another example of where information can be dubious. You have probably noticed that Wikipedia invites individuals to provide reference sources to validate the data as reliable.

Link

For more about factors affecting the quality of information see *Unit 5: Data Modelling*.

For more on reliability of data see Methods of ensuring data accuracy.

Data generates an audit trail just as you do when you produce your assignments. You will be expected to reference your sources to validate their reliability. You are guilty of plagiarism if you claim that any of the work is yours when it has been directly taken from other sources. Plagiarism is a serious offence.

Reflect

How would you feel if you discovered that someone had copied your work or repeated something you had suggested and claimed that it was their idea?

The characteristics and implications of methods of collecting data and opinions

Data can be gathered in many forms and, potentially, even without a person's knowledge or consent. This section focuses on different methods of gathering data and opinions.

Survey

Qualitative data is data that is based on categories, such as colour of hair or make of car. Quantitative data is data that is based on numerical measurements, such as height. Surveys include instances where individuals are asked their opinions, perhaps about their experience with a hair product or a leisure event. Market researchers may approach people in busy shopping streets or centres, but now more surveys are conducted over the phone or online. Online surveys save businesses time and money. Online surveys encourage users of websites to give feedback and opinions on products or services they have used. Often this feedback can be used to rate

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those products or services. Once such example is Trip Advisor, where customer reviews and ratings form the advice that users are given about hotels and restaurants, for example.

Attempts are made by companies using online surveys to ensure the reliability of the data. Otherwise, a business may find themselves blacklisted by users. Surveys such as these have limited usefulness because it is difficult to measure and compare individual opinions as each person's experience is personal and biased.

Questionnaire

You may have completed questionnaires at your place of study, perhaps to provide information about your personal experience as a student and as a measure of your satisfaction with the quality of the teaching or facilities. Questionnaires tend to be more structured than surveys and, although they are still open to an individual's opinions, the data gathered can be more useful as it can be made quantifiable. For example, specific questions can be asked and users can rank their answers from 1 to 5.

Regardless of method for gathering data, assurances should be given about the purpose for gathering the data and also about the use of any personal data which could identify the individual.

Tip

Producing questions which generate the responses you need to answer a specific research question is quite difficult. Keep the questions simple and, if you are seeking opinions, avoid closed or leading questions which rely on yes/no answers. If you ask open questions (how, why...) consider how you are going to analyse the responses as this will help you word the questions appropriately.

Focus groups

Using focus groups is a useful method of gathering information from groups of individuals with a similar interest which, although they are often held on a face-to-face basis, only require each question to be asked once to each group. However, the information gathered can be less reliable where responses are skewed by the solidarity of a group or reticence to provide detail and be identified as the source of an opinion.

Interview

Interviewers can gather information or provide information or both. An interview is a very powerful method of data collection as it is interactive and allows the interviewer to probe for clarity and gain a really clear understanding of the views canvassed. The difficult part of this method is getting respondents to agree to be interviewed as it can be seen to be really quite intrusive. A systems analyst or developer can use interviews to excellent effect to gain an insight into a user's working life and therefore produce a system more ideally suited to their needs. An interviewer must be well prepared and knowledgeable of the intended outcome, as they may be called upon to provide information during the interview.

Reasons for ensuring data accuracy

Inputting accurate data is crucial to business operations. Unfortunately, we all make mistakes and cannot eradicate human error which is why it is so important to ensure that procedures include checking data entry and that systems are designed to undertake validity checks. You will learn more about what that means and how to do this later in this section.

With technology advancements and the reliance on having vast amounts of information just a click away, we are becoming more intolerant when we do not get the information we expect. This could be because we have typed in the wrong questions, or that the information received is inaccurate. You may have noticed, in the disclaimers on the Wikipedia website, concerns about the validity of the data and requests for site users to provide sources and verify its accuracy.

Reflect

Identify an occasion when your information was inaccurate or not found, perhaps when you contacted a business about the guarantee on an item or to seek support using software or a device you recently purchased. Ask yourself what might have happened if the information was not located. If you were the employee searching for the information, what questions would you ask or what strategies would you try to locate the information?

Discuss your example and conclusions with a peer.

Theory into practice

With a peer, explore the implications of your medical records going missing or if they were inaccurate so that you were mistaken for another patient. What methods could be used to ensure that this did not happen?

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There are many reasons why data may be inaccurate. For example:

- careless data entry (spelling mistakes, inaccuracy)
- misheard or misread data
- duplications
- inadequate **data cleansing**
- omissions (gaps in data should always be avoided).

Key term

Data cleansing – ongoing checking of data for accuracy, currency and completeness.

It is likely that you have wrongly dialled or stored a telephone number by missing out a digit or putting them in the wrong order. In business, it is vital that data is input accurately and that it is checked frequently. For example, if addresses of Amazon customers became jumbled or were entered inaccurately, then orders would not be received by the people who purchased them.

If a business orders the wrong stock or amount, they could lose custom or find that they have a large amount of stock which they cannot sell and for which they have paid in advance. Inaccurate data is useless data.

Theory into practice

With a peer, produce a questionnaire which can be used to gather data on eating preferences of young adults. Select how you will gather your data and analyse the results. Compare with secondary sources and evaluate the outcome.

Share your experiences with your peers and identify what went well and why, and what you would change if you were to undertake this study again.

Methods of ensuring data accuracy

There are two methods for ensuring the accuracy of data: verification and validation.

Verification

Verification means checking the data with its original source to find inaccuracies. Another method is to enter the data twice and check against both versions.

Validation

To validate data requires a preprogrammed instruction, perhaps a macro or set of parameters, designed to check that the data makes sense and appears reasonable. For example, if the parameters cover a range between 50–80 and the entry is 95, then this will be identified as an error.

If the parameters expect specific data types, such as your postcode, then any inaccuracy will be recognised. This restriction is known as an **input mask**. Parameters can also be set to refuse blank fields so that omissions are not allowed, for example in a National Insurance number, which is unique to every individual.

The process of validation does not check for inaccuracies just as a spellchecker in Microsoft Word cannot proofread. In other words, the program will check whether a word might be misspelt but is not able to identify a wrong telephone number or a missing word. Each of these entries might be recognised as valid entries by the spellchecker, although they may be inaccurate.

Link

For more about Validation and verification of data, see *Unit 5: Data Modelling*.

Key term

Input mask – a database instruction which restricts or controls the type, format or amount of data entered.

Methods of extracting and sorting data

Digital **databases** enable the extraction and sorting of data with ease. Actually, any file containing a collection of data which can be manipulated in some way to provide an answer, such as using a spreadsheet to sort information numerically and alphabetically in either direction, can be referred to as a database. For example a list of numerical values can be sorted from low to high and *vice versa*, or words can be alphabetically sorted A–Z or Z–A.

Data can be extracted very quickly and simply using a filter. All data entries containing an exact match are filtered. This works with simple **queries** using a single criterion at a time.

To extract more complex data, constructs using more than one criterion require a more complex query and, for this reason, a dedicated database software program is more likely to be used as it will include the facility to construct queries using multiple criteria. A query can be created in a digital database using another query, which may be referred to as a nested query, rather than recreating a query which repeats the criteria already included in an existing query but requires a refined result.

For example, an existing query might interrogate a database to find all those customers who made a purchase in August 2016 and a new query might be designed using this query and then refining it by asking for all those customers in Birmingham who purchased during that period. Queries can be saved, so those you are likely to need again do not have to be recreated.

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Link

For more about databases and queries, read *Unit 2: Creating Systems to Manage Information*.

Key terms

Database – a collection of data which can be in digital or paper form, such as a telephone directory.

Query – a way of interrogating data by applying a set of criteria.

Numerical and data modelling

The processes of numerical and data modelling are used in software engineering.

Numerical modelling

Numerical modelling is the process of producing a mathematical model to perform predetermined actions such as calculations in a spreadsheet. An individual might design a numerical model to calculate their personal finances and manage their budget. A business will use numerical modelling to forecast sales, manage their cash flow and perform projections for future business growth.

Financiers will use numerical modelling for making assumptions about potential growth in stocks and shares or movements in interest rates. Numerical models use formulae and equations and the results can also be used to **amortise** payments over periods of time.

Key term

Amortise – gradually write off the initial cost of an asset over a period of time, because regular payments are made.

Data modelling

Data modelling means to create a conceptual image (a model) of the meaning of the data in order to help consider alternatives. Modelling the data in different ways enables you to evaluate the usefulness of the model and how to justify decisions. Databases are set up to make use of a particular set of data and are modelled in a particular way so as to find out specific information. For example, your place of study needs to keep records of every student, which includes:

- personal details
- course studied
- progress
- study support.

The planning of a database is almost more important than the final product. A procedure is required for ongoing maintenance to ensure that the database provides the required information and initial testing should be carried out before any data is input into the database in case changes need to be made to the data model.

Databases can be planned out on paper and each of the features required needs to be defined to ensure that parameters are in place so that the data, when entered and manipulated, are retained. Each line of entry is called a record and each of the records will be broken down into fields, for example:

- title
- first name
- last name
- house name/number.

Each field will need to be identified as a particular datatype, for example:

- text
- number (integers, currency, decimal).

Each field needs to have its parameters set, for example:

- format (capitals, lower case, numbers and/or letters)
- length (number of characters).

One of the most important features of a database is to ensure that data is stored efficiently and robustly; the most effective databases minimise repeated and redundant data. Queries are used to perform database searches to provide the data required at any particular time.

The planning stage involves refining the database model so that data is stored in separate compartments (tables) which all have something in common so that they can relate to each other. Unlike a spreadsheet or word-processed table, which are usually single tables (flat files) and can become unwieldy, an effective database relies on relationships with other tables in the same or from other databases.

Link

For more about databases, queries and relationships, read *Unit 2: Creating Systems to Manage Information*.

For more about data modelling, read *Unit 5: Data Modelling*.

Presenting data and results

The tables containing the raw primary data are known as the backend of the database. These tables are usually protected and inaccessible to those inputting data to avoid deletions and threats to data integrity. Routine actions are performed at the frontend, known as the dashboard.

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Well-planned databases include a variety of methods and means of presenting the data and the results from the interrogation of data, through data modelling. These include:

- Reports – Combining text, images and numbers. Calculations can be performed by a database and presented in different formats in a report.
- Forms – Raw data can be merged into a predefined form, such as a registration form, perhaps to be completed or signed by the person registering at a leisure centre.
- Graphical representation – Numerical data can be presented as a graph and integrated into a report.

Once the database has been set up properly and considerable thought has been given to anticipating what will be required from the raw data (that is, whether it has been modelled correctly), these actions can be performed very simply and easily.

Link

For more on user interfaces (dashboards) and presenting data, see *Unit 5: Data Modelling*.

The characteristics and implications of user interfaces for data collection and processing systems

You are likely to be familiar with systems that are designed to contain or gather and process data. You may have designed a database or possibly used one which was designed for a business, such as a customer database or for stock control.

As databases become increasingly sophisticated, we are largely unaware of the philosophy involved in designing such a system. If you use a spreadsheet to manage your personal finances, this could also be viewed as a sort of database and you will have thought about how you will structure it, that is, the headings for the columns and rows. You may use a filter or sort the data and possibly you will include some formulae to perform calculations. You may have created a database using software such as Microsoft Access and begun to become familiar with the complexities of how to structure the database to ensure that it meets its intended purpose.

When you store the contact details of your friends and family in your phone, this information is contained in a database. As mobile phones have become more sophisticated, your input into gathering and storing this information becomes minimal. For example, recent smartphones can seek out content from messages and emails and then prompt you with a suggestion that new data should be added to existing records or that a new record be created.

Therefore, if you are designing a database system for storing a list of your contacts or for manipulating data for a research project, there are many aspects to consider long before structuring or implementing the system. You will explore some of these aspects now.

Ease of use

The intention of every database is to input, manipulate and extract data with ease. Basic requirements to ensure ease of use are things such as titling fields to avoid ambiguity or misinterpretation, for example using the term first name rather than Christian name, and last name rather than surname.

Accessibility

The dashboard is the user interface which provides users with guidance on how to use the database. For example, an icon might say 'data entry' which, when pressed, will open the window to where new records can be entered.

Depending on the design of the dashboard, databases can be made accessible to the majority of users. Points to consider include:

- language and terminology
- colour
- size of dashboard, text and icons
- layout
- position (where the dashboard sits in relation to the monitor used)
- number of clicks to perform each action.

Link

For more about accessibility, see Accessibility of devices.

Error reduction

User interfaces should be designed to reduce or prevent errors when entering data. If an input mask or other parameter has been implemented, a warning message should appear informing the user about why the data are being refused. Any attempt to delete or alter a record should be preceded by a warning.

Intuitiveness

A well-designed database should be intuitive to use and not require intensive training for daily use. The more sophisticated or bespoke databases often require considerable training over longer periods of time. Making the layout of an on-screen form match that of a physical form aids intuitiveness, as the system is immediately familiar.

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Functionality

As database users and those requiring reports generated from the raw data expand their needs and review its capabilities, the database can be refined or expanded to become even more functional. For example, as a business increases its range of products or services, the database might need to be expanded or generate new reports. A business will input employee records and may expand the database to automatically generate salary adjustments based on appraisal outcomes.

This ongoing maintenance relies on the initial structure of the database being sufficiently well thought through during the design process as any changes can affect the integrity of the data.

Performance, usability and cost

User interfaces enable greater performance and usability by reducing the complexities and potential fear attached to using a database, particularly for users less familiar with technology. However, database software can be expensive, especially if designed specifically for a business using a bespoke system. Databases also demand greater storage capacity and performance from IT systems.

Compatibility

Using a database from a software suite, such as Microsoft Office, provides advantages in that the format of the data is compatible to other programs in the suite and is often recognised by other software packages. For example, the ability to export data using a **CSV** file type.

Key term

CSV – comma-separated values is a file type which stores records in a line and presents data in plain text as individual fields, where each field is separated by a comma.

Case study

IT enterprise risk management for CESG Digital

CESG is the information security arm of GCHQ, and the National Technical Authority for Information Assurance within the UK. This means that they are the definitive voice on the technical aspects of information security in Government. CESG works in partnership with industry and academia, the Centre for Protection of National Infrastructure (CPNI), MI5 and the Secret Intelligence Service (MI6). The team working on risk management needed a solution to create and share documents. The team put together a small enterprise IT service and the choices they made formed part of a series of blog posts. They initially set some overarching principles, which were, in summary:

- manage risk responsibly
- take decisions based on evidence, react promptly to events, and seek expert advice when needed
- be sensible when making technological decisions that result in risk
- record significant decisions.

The team do not have a separate risk management process, but that they make sensible decisions throughout their project, based fundamentally on security. Basic initial principles included identifying:

- the needs of the users
- the information they expected to secure
- rules for how different types of data would be handled
- which decisions and risks could be taken in-team and those that needed escalating.

For each technological decision, they followed this process.

- They assessed each set of options or approaches against user needs.

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- For each option that met user needs, they assessed how well it fitted with decisions made previously and how it measured up against the security factors that were most important for this particular decision.
- They made decisions based on assessments, with a preference for the most usable service that was acceptable against other criteria.
- They escalated the decision if they did not feel empowered to make it locally.
- They recorded the decisions made and tracked any risks which were not fully mitigated.
- They made sure that the right people were in their team, and ensured that those people were trusted by accountable people (outside of the team) to make decisions which they would support.
- All decisions would consider a range of viable options, with decisions made on the basis of evidence and professional judgement.
- Important decisions would be discussed in the team, with two or more people being responsible for more challenging decisions.
- Risks would not be taken if the team did not feel empowered, informed or qualified to take them.
- Help would be sought when required from independent experts in specific areas.
- The team agreed to follow this approach.

They used the Cloud Security Principles, the End User Device Security Principles, or asked some of their security experts what the most important security considerations were for any given decision, and assessed the viable options against them. They also:

- recognised that security needs to be adequate for the purpose
- demonstrated why they made the decisions
- accepted that there will always be uncertainty
- ensured that the business understood the risks it was taking
- were careful to speak in plain English in all internal workings and external outputs
- acknowledged that everyone is part of the delivery team
- recognised that decisions are interconnected.

Because this is a new approach for CESG, they are missing some supporting tools to help track decisions and resulting risks effectively. They used documents to do this, but would like to use a web tool to help with this in the future and some tools to help produce summaries and understand quickly how much cumulative risk they are exposed to.

Check your knowledge

1 Why did CESG need a secure system?
2 How did they go about starting the project?
3 Name at least 5 factors that CESG believe are important when embarking on projects
4 What plans do CESG have for improving their procedure further?

Discussion

Discuss this case study with your peers and identify further improvements for your information security procedures.

PAUSE POINT

What risks can you identify from CESG operations in the case study above and what procedures would you put in place?

Hint — Read through the Cloud Security Principles and CESG blogs at www.cesg.gov.uk and www.gov.uk.

Extend — Draw a diagram which demonstrates how you have developed a procedure for protecting your data and information.

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F Issues

The final section of this unit explores further the concepts, impacts and implications of issues resulting from the use of IT systems.

Moral and ethical issues

What we use IT systems for and how we use or access them can raise **moral** and **ethical** issues. In this section, you will learn more about the implications for individuals, organisations and wider society of the moral and ethical factors of using information technology.

Key terms

Moral – principles about what is right and wrong behaviour.

Ethical – relating to the knowledge of moral principles: that is, how we behave.

Reflect

What are your principles and values? How do they compare with those of your peers? What influences your views of what is right and wrong?

The moral and ethical factors of the use of information technology

Our views about morality and ethics will differ depending on our cultural backgrounds. An example of morally and ethically poor practice relates to the ease with which pay-day loans can be activated online or over the phone, enticing vulnerable adults to sign up to high interest rate loans that they cannot afford to pay back.

Privacy

It is not unusual for someone to experience onlookers when reading or writing messages or emails, or for someone to be listening in to phone calls. Some users are quite happy to share their devices but, morally, it is usually considered impolite to engage in others' conversations, whether verbally or digitally, without being invited.

It is not uncommon, however, for conversations to take place over mobile phones in public places without any consideration to others around, even if the content is somewhat sensitive or private in a business context. Likewise the use of multimedia in public places where others are subject to interference and noises, particularly in places designated as quiet areas, such as some train carriages, libraries or waiting rooms.

Personal details are often unwittingly shared with others in public areas by people working in professional situations. Examples include hotel receptionists repeating customer addresses and phone numbers during check-in and doctors' receptionists sharing patients' phone numbers and dates of birth to verify their identity.

As soon as you begin placing personal details online there will be concerns about privacy. Who is storing your data, where is it stored physically, who has access and how is it protected? While there is legislation to protect your personal data, as discussed earlier in this chapter, it is useless if the holder of the data is not in the same jurisdiction as you. Wherever you choose to store your personal data, it is always worth taking note of the privacy policies listed on websites as to what you are agreeing to, that is, what can they do with your data?

Theory into practice

Keep a log for a day as you go about your daily activities, making notes about your regular habits when using any digital device. Note also how others behave and log the circumstances and location of each event.

Assess the impact of these actions and what the risks are regarding the potential invasion of privacy or inadvertent sharing of private data.

What changes will you make to how you will respect others' privacy in the future and what can you do to mitigate the risk of others inadvertently sharing your data?

Carry out this activity again in two or three weeks' time. Have you changed your behaviour? What else have you discovered from this activity?

Environmental

Factors of morality and ethics affect the environment. One well-known example is the disposal of IT equipment such as hardware and printer cartridges, which may be carcinogenic. The use of technology also impacts on the environment by draining natural resources and adding to our carbon footprint.

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Despite this, the environment has benefited indirectly from technology because users can gain a better understanding of ways to improve and maintain the environment and those within it by sharing information globally. For example, charities can promote their messages and seek funding from numerous sources. However, morally this method of promotion can also be considered as invasive, especially when TV appeals are shown at mealtimes when they are likely to gain the attention of millions of viewers. Sharing images of those considered less fortunate than ourselves, especially where actors are used to portray misfortune, can be considered immoral.

Research

With a peer, identify at least five examples of risks to the environment due to immoral or unethical practice.

Search for case studies of major organisations. You could start by searching government websites.

Unequal access to information technology

Another ethical and moral consideration is the inequality regarding access to IT. Although much is being done to improve the access to IT systems for all people, through adapted devices or assistive technology, there is still a large percentage of the world's population without any access to IT systems at all.

In 2015, it was estimated that almost half of the population of the world had no access to the internet but that does not indicate how many actually are without any technology. Google and Facebook have initiatives to bring internet access to developing nations. In the more privileged countries, such as the UK and USA, a child without the latest technology can feel stigmatised and disadvantaged when compared with their peers.

Online behaviour and netiquette

There are differing opinions about how to behave online. You may have devised your own rules as peers and decided what is acceptable and what is not, such as the way you write messages, and you might start and sign off with terms of endearment that you would not use when communicating with your employer or teacher.

Generally, you should follow some basic rules of **netiquette** regardless of cultural background:

- never use abusive language
- do not harass others with demands or personal questions
- if a third party is asked to join a discussion, give them access to the string of previous messages in a discussion
- get permission before sending other people's content to a third party
- do not share personal information (yours or other people's) insecurely or unnecessarily.

Key term

Netiquette – a word derived by combining internet (net) with correct behaviour (etiquette); it is especially related to online discussions and forums but also emails.

Tip

Read the online behaviour and netiquette protocols relating to the online communities you are using.

Theory into practice

Check if your place of study has a netiquette policy. Review the current policy and make recommendations for changes to reflect latest developments relating to moral and ethical behaviour.

Globalisation

As the world is interconnected by the use of IT, the moral and ethical issues appear greater. For example, advertisers need to consider the impact of their promotional material on multi-cultural groups and economic situations.

Research

'The gap between rich and poor is still very large...40% of the world's population live on less than $2 per day'. For more about the ethical dilemmas of globalisation visit www.ethicalfocus.org.

What examples can you identify of inequality due to globalisation? How would you judge whether this inequality is immoral and unethical? Discuss with a peer.

Freedom of speech and censorship

There appears to be conflict between the ability to exercise freedom of speech and the suppression of speech through censorship. Morally and ethically, freedom of speech should follow protocols such as those explored earlier: that is, netiquette.

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Acceptable use

Many businesses implement acceptable use (of IT) policies (AUP) which state protocols for what are deemed morally and ethically acceptable, including:

- constraints (websites, activities, time)
- devices (types and their use, including whether personal devices can be used for business activities and vice versa)
- security (complying with legislation, keeping data secure).

Link

For more about AUPs, visit http://whatis.techtarget.com.

The purpose and role of codes of practice produced by professional bodies for the use of IT systems

In the section Protecting data and information, you began to learn about codes of practice for the protection of data and you will now explore further the purpose and role of codes such as those produced by the:

- Information Commissioner's Office (ICO)

Link

For more about the Information Commissioner's Office (ICO), visit https://ico.org.uk/.

- Care Quality Commission

Link

For more about the Care Quality Commission, visit http://www.cqc.org.uk/.

- Chartered Institute of Library and Information Professionals.

Link

For more about the Chartered Institute of Library and Information Professionals, visit http://www.cilip.org.uk/.

The purpose of codes such as these is to protect users and customers and to provide assurance regarding data protection and also clear guidance about their values. Values are based around moral and ethical considerations.

The impact of codes of practice on individuals and organisations

Codes of practice are also self-regulated, which means that any individual can report a breach as a cause for concern for investigation to the organisation itself, rather than to an independent body. Each of the promises identified in the code of practice will also be formally monitored and regulated. Therefore anyone in breach of any aspect of the code of practice will be dealt with in accordance to the organisation's policies and legislation.

The benefits of having a code of practice are consistency of use of an IT system and that it provides a set of common ground rules to avoid misunderstandings or misinterpretations. Individuals are responsible for making themselves aware of the requirements of such codes.

Legal issues

There are many examples of where individuals' personal data have been violated, such as hacking into bank accounts or stealing personal identities. We shall now explore some of the legal issues relating to the use of IT systems and the implications for individuals, organisations and wider society.

The role of current legislation (and subsequent additions and amendments) in protecting users and their data from attack and misuse

We all have opinions about legal, moral and ethical issues, particularly if it affects someone close to us. However, as you may have been discovering, we do not all share the same views, nor can we do much about what we consider to be an injustice without the support of greater forces, such as that provided by government legislation and enforcement.

As technology and its uses continue to evolve and expand, legislation is reviewed for its currency and updated to combat risk. Ensuring legislation is fit for purpose in accordance with current expectations and behaviours is really complicated, as laws must work together in harmony and not contradict other laws. Hence working parties devote considerable time and effort to producing legislation based on many sources of data which are gathered, analysed and evaluated.

Businesses and individuals are responsible for ensuring that they are aware of current legislation and any changes. You will note from the following examples that amendments, additions and convergences exist to address the changes.

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Link

Full legislation and amendments can be found at http://www.legislation.gov.uk/.

Computer Misuse Act 1990

The Computer Misuse Act 1990 is a generic set of rules prohibiting unauthorised access to data and unlawful treatment of data where access is permitted. The act links to other legislation by identifying the scope of the legislation and the territory covered by the act. Changes are currently being made to keep up with technological developments over the last 25 years. The Computer Misuse Act lists 3 basic offences. These are:

- unauthorised access to a computer system – punishable by up to 2 years in prison and a hefty fine
- unauthorised access with intent to commit a criminal act – punishable by up to 5 years in prison and a hefty fine
- unauthorised access and modification of a computer system – punishable by up to 10 years in prison and a hefty fine.

The act covers all offences, ranging from minor intrusions into a company database by an employee to an incident that may impact on national security.

Police and Justice Act 2006 (Computer Misuse)

The Police and Justice Act 2006 (Computer Misuse) expands on the impact of breaching the Computer Misuse Act through amendments which include:

- penalty by imprisonment and/or fine
- length of imprisonment
- making explicit the constituents of unauthorised acts, such as making, supplying or obtaining offensive material.

Copyright Designs and Patents Act 1988

The Copyright Designs and Patents Act 1988, also referred to as the CDPA or CDP Act, sets out the rules for copyright and artistic licence relating to all multimedia, specifically:

- broadcasting
- films and recordings
- ownership
- databases, computer design and backup copies
- rental and loans (differentiating between permissions for public and personal use)
- accessibility (typefaces, printing).

The Copyright (Computer Programs) Regulations 1992

The Copyright (Computer Programs) Regulations 1992 expand upon the CDPA in terms of:

- jurisdiction (Northern Ireland is included)
- literary work (preparatory design material for a computer program is included)
- restrictions to issuing copies of, adapting or converting computer programs
- permission to back up copies of programs when for lawful use.

The Health and Safety (Display Screen Equipment) Regulations 1992

The Health and Safety (Display Screen Equipment) Regulations 1992 sets out rules for using 'any device or equipment that has an alphanumeric or graphic display screen' because of the implications to health, in particular **RSI**. The Regulations advise taking regular breaks and engaging in other activities to reduce the risk of RSI. Businesses are required to consider the moral and ethical issues of employees expected to spend extended lengths of time in front of computer screens.

Link

For more about the Health and Safety (Display Screen Equipment) Regulations, visit http://www.hse.gov.uk/.

Key term

RSI – repetitive strain injury.

Data Protection Act 1998

Copying someone else's data without their permission or acknowledgement is against the law and both morally and ethically inappropriate. The Data Protection Act 1998 extends beyond the obvious restrictions in sharing data and also includes rules about disclosing and the use of data.

For example, a business must disclose the use of telephone or CCTV recordings. The law requires businesses to notify the ICO as to why they are using CCTV. It would not be morally or ethically acceptable for a business to use CCTV for observing staff working.

Link

For more about data protection in regards to the use of CCTV, visit www.gov.uk.

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Guidelines and current legislation (and subsequent additions and amendments) designed to ensure the accessibility of IT systems

Legislation is there to protect everyone and ignorance is not excusable in the eyes of the law. Businesses often monitor compliance by appointing someone to remain up to date with changes to legislation and to implement procedures for employees to follow.

Disability Discrimination Acts 1995 and 2005

The Disability Discrimination Acts 1995 and 2005 (DDA) legislate against unlawful discrimination of those with disabilities and with specialist needs such as learning difficulties. (These acts have now been repealed and replaced by the Equality Act 2010 (except in Northern Ireland).) Discrimination can occur when those intended to be protected by the law do not have the same rights or access as those without these characteristics.

A business cannot discriminate when recruiting or employing staff by the way they advertise or the duties to be undertaken. Neither can they discriminate against customers gaining access to services or products. For example, a recruitment advert which is inaccessible to those with visual impairment or a job requiring use of IT without provision made for adaptive or assistive technology would be in breach of the law.

Equality Act 2010

The Equality Act of 2010 has replaced the DDA to promote equality regardless of characteristics. For example, it legislates against unlawful behaviour such as that described in the previous section and makes explicit the characteristics of vulnerable groups, known as those with protected characteristics.

Link

For more about the Equality Act 2010, visit www.equalityhumanrights.com.

British Standards Institute (BSI) codes of practice

The BSI includes the code of practice known as whistleblowing. The whistleblowing code permits the right of individuals and employees to 'blow the whistle' on those in breach of legislation.

Link

For more about the BSI ,visit http://www.bsigroup.com/en-GB/, and for more about whistleblowing, visit http://www.pcaw.org.uk/bsi/.

Perhaps you feel that a fellow student is being discriminated against by being excluded from accessing some specialist software needed for their course, which is available to everyone else; then you might report it to the appropriate person.

Open Accessibility Framework (OAF)

The purpose of the OAF is to 'conduct research...to enable the development of embeddable assistive technologies for the desktop and for mobile devices'. The six framework steps are:

1. define accessible
2. stock elements
3. development/authoring tools
4. platform support
5. the app itself
6. assistive technology.

Link

For more about the Open Accessibility Framework, visit http://www.oaeg.org/.

Web Content Accessibility Guidelines (WCAG) 1.0 and 2.0 and World Wide Web Consortium (W3C®)

In 1994, Tim Berners-Lee founded the W3C to initiate universal accessibility codes of practice for accessibility of the internet. The WCAG defines guidance for creating web content which avoids discrimination, by providing three basic tips on:

- user interface and visual design
- writing and presenting content
- markup and coding.

Link

For more on the WCAG, visit http://www.w3.org/.

As the use of the internet continues to grow and develop, W3C® continues to strive to eradicate inaccessibility, for example, by, defining terminology, user needs, providing guidelines and resources for use and designing for inclusion, such as mobile accessibility and content.

Link

For more about mobile accessibility, visit www.w3.org.

The moral and ethical factors in the use of IT systems

This section covers the moral and ethical factors involved in the use of IT systems.

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Health and safety

Health and Safety is all around us and there exist many risks when using digital devices. If we look at the traditional office workstation, users should ensure that they take frequent breaks from using screens, keyboards and other peripherals, and they should be provided with fully adjustable seating to prevent RSI and back problems. Employees are entitled to DSE (display screen equipment) risk assessments to consider their specific needs if they regularly use IT equipment. Trailing cables, glare, eye strain, electrical concerns and work–life balance all present their own health and safety risks.

Outside the workplace, less obvious factors include using digital devices which could cause a fire, such as:

- using a digital device at a petrol station
- using digital device as a torch to locate a gas leak in a dark space.
- In addition, digital devices should not be used when crossing a road or when driving or controlling machinery. The frequent use of smartphones may cause RSI due to constantly performing fine motor movements to interact with a touch screen.

Theory into practice

Ask your tutor for your centre's DSE risk assessment and carry out a risk assessment of your workstation in class. What could you do to mitigate any risks you identified?

Copyright

Copyright laws and plagiarism rules are the same whether content is copied from a paper book or digital material and whether it is text, image, sound or any other media which you have not created. It is all too easy in the digital age to accidentally breach copyright legislation. Simply using an image from Google Images, for example, in a website could result in a lawsuit for unauthorised use of images. If you are using images found on the internet, it is essential that you obtain permission to use them. There are many sources that are licensed under the Creative Commons licence which allow easy reuse with a clear conscience and free of the risk of potential legal action.

Computer misuse

Using a computer other than your own should be within the realms of the regulations laid down by the owner, whether a friend or a business. Conducting personal activities using a business computer or other device without permission, whether in work time or over a break, can be viewed as immoral and unethical. This is because the data on that computer or in the network it is attached to is put at a greater security risk through your personal use of it. Using a company mobile for personal communication and other use is also not moral or ethical unless agreed to by the company.

Protection of data

It is your responsibility to protect your data and also to protect the data belonging to others. Simple precautions such as locking access or not copying or removing data from its original source should be followed. Using the internet through public access puts data at risk of exploitation. Ensure that you are not looking over someone's shoulder when they use an ATM or a PIN number for a transaction, and make sure that you are not overlooked when you are doing the same.

Privacy

It is neither moral nor ethical to listen to others' telephone calls or to read another's emails without permission. Equally, it is not appropriate to randomly capture images or record videos without the permission of those in the image or recording, or to post the content onto the internet.

Accessibility

Creating or accommodating a situation which discriminates someone from using IT systems is neither moral nor ethical. Therefore accessibility and inaccessibility are important considerations whether programming, producing a blog, typing an email or leaving a message.

Further reading and resources

Websites

Useful websites for further information relating to Unit 1:

- http://www.cisco.com/
- http://computer.howstuffworks.com/
- http://www.dummies.com/
- https://books.google.co.uk/
- http://www.howtogeek.com/
- http://www.ibm.com/
- https://technet.microsoft.com

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Assessment practice 1.4

A01 A02 A03 A04

The Canadian Health Commission (CHC) is looking to improve the data collection system across the health care system in Canada by introducing a standardised approach. The problem they have identified is trying to overcome the challenges faced when trying to collect data on patients' race, ethnicity, language and communication needs.

The organisation is striving to create a comprehensive system that combines data collected from multiple agencies, which include:

- hospitals
- community health centres
- physician practices
- health plans
- government or federal agencies.

The organisation recognises that each agency faces opportunities and challenges in how to collect the data sensitively and consistently.

To identify the next steps towards improving data collection they have recognised that, in some instances, the opportunities and challenges are unique to each type of organisation while, in others, they are common to all, including how to:

- ask existing and potential patients questions about race, ethnicity, and language and communication needs
- train staff to elicit this information in a respectful and efficient manner
- address the discomfort of registration/admission staff about requesting this information.

You have been asked to:

1. write a report which might help them solve the problem of how staff could elicit sensitive information consistently, perhaps by producing a checklist or questionnaire
2. include an evaluation of UK codes of practice
3. analyse and synthesise codes of practice from UK and W3C®
4. provide recommendations for CHC justified by your findings.

Plan

- What do I need to find out?
- What is my timeframe?
- What will the structure of the report look like?
- How can I demonstrate that this meets the required standard for distinction?

Do

- I know how to locate where my weaker areas are and how to improve.
- I understand what is being asked of me.
- I can check that all the criteria are met.
- I can make improvements to my analytical and evaluating skills.

Review

- I can describe how to improve further.
- I can recognise my strengths.
- I can explain how I tackled each part of this activity.
- I can explain how this knowledge and experience will be useful to me elsewhere.

PAUSE POINT What ethical and moral factors feature in this assessment activity and on whom do they have an impact?

Hint Try exploring other case studies or talking to a mentor or business colleague.

Extend How would you develop an outline for logging the data electronically?

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THINK FUTURE

Tom Churchill, BTEC National Student

It wasn't until I was part way through my BTEC National that I started to realise 'I can do this!' I joined the course mainly because I didn't know what else to do and I like computers. I don't mind admitting I was worried I wouldn't make the grade but I enjoyed studying.

So after getting some careers advice from my tutor and student services I found a Uni course I fancied and applied. It meant filling in a UCAS form and I wasn't very confident but I had help to write about what I am good at and why I wanted to go into higher education. I can't wait to go on to do a degree as I shall be the first person in my family to go to Uni. I have done some research about possible jobs in the future and it seems they're crying out for software developers.

It wasn't until I talked to my parents about my plans and they asked me to explain what software developers do that I realised I needed to be more focused. When I looked through the courses again I realised I needed to be specific in what I wanted and identify what my strengths were. I also realised then that I wanted to make a success of the course and not struggle with something that might not interest me. I especially enjoyed learning about design philosophy and knew that my creative skills would be useful when designing software.

I explained to my parents that I would be preparing for a job where I would work in a team on projects which might also involve me researching clients' needs to inform the design. This got me thinking about the research I had done on this course and how much I had developed from when I first started. I must admit I didn't think very hard about the information I found and now I know about ways to check it is accurate before relying on it. However, I have a lot more to learn.

My parents are proud of my achievements so far and especially pleased that I have a mission to follow! Most of all, I am proud of myself and can't wait to continue my journey. I'm not saying it's going to be easy though!

Focusing your skills

Skills health check and preparing to apply to higher education

It is important to promote the skills you have gained as they can be used in the future in lots of different situations. Here are some ideas for you.

1. Make a list of the skills you have and how they will help you in higher education.
2. Divide your list into four skills sections: employment, creative, study, social.
3. Rate each one to identify what you are really good at and what you need to improve on.
4. Ask someone who knows your skills well to check your list in case you have missed anything.
5. Research the variety of higher education courses on offer and read through the syllabus of those you find most interesting.
6. Arrange to visit some universities that offer courses that interest you to assess which suits you and where you might fit in best. Perhaps start by visiting https://www.ucas.com.
   - You should also consider preparing for any visits and possible interviews by producing:
     - an updated CV
     - examples of where you have applied your skills as a student or employee
     - a list of sensible and interesting questions
     - a bibliography of your sources used for research and your application.

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Getting ready for assessment

This section has been written to help you to do your best when you take the external examination. Read through it carefully and ask your tutor if there is anything you are not sure about.

About the test

The set task should be carried out under supervised conditions.

- You must not bring anything into the supervised environment or take anything out without your tutor's knowledge and approval. You will need to use a black ink or ball-point pen. Make sure you bring one with you and it might be sensible to have a spare as well.
- You should make sure that you back up your work regularly. You should save your work to your folder using the naming instructions that will be indicated in each activity.
- Do not forget anything else you might need, such as glasses for reading the assessment paper.

Preparing for the test

This unit is assessed under supervised conditions and the number of marks for the unit is 90. Pearson sets and marks the task.

The marks for each question will be shown in grey boxes next to each question. Use this as a guide as to how much time to spend on each question.

Additional information and stimulus material needed to answer the questions can be found in the additional information booklet.

The external assessment will last for 2 hours. You will be assessed on your understanding of IT systems and the implications of their use in personal and professional situations.

The assessments for this unit are available in January and May/June each year.

Make sure that you arrive in good time for the assessment. Check that you have everything you need for the test ahead of time. Plan out your time to ensure that you leave yourself enough time to complete all of the questions and to check through your work at the end. Try to answer every question. Proofread and correct any mistakes before handing in your work. Ensure that you have checked all sides of the assessment paper before starting.

Listen to, and read carefully, any instructions you are given. Lots of marks are often lost through not reading instructions properly and misunderstanding what you are being asked to do.

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Key terms typically used in assessment

There are some key terms that may appear in your assessment. Understanding what these words mean will help you understand what you are being asked to do.

The following table shows you the command words that will be used consistently in your assessments to ensure that you are rewarded for demonstrating the necessary skills.

Please note: the list below will not necessarily be used in every paper/session and is provided for guidance only. Only a single command word will be used per item in your test.

Key term	Definition
Analyse	Learners examine in detail a scenario or problem to discover its meaning or essential features. Learners will break down the problem into its parts and show how they interrelate. There is no requirement for any conclusion.
Assess	Learners give careful consideration to all the factors or events that apply and identify which are the most important or relevant. They make a judgement on the importance of something.
Calculate	Learners apply some form of mathematical or computational process.
Complete	Learners complete a diagram or process. This can apply to problems/solutions of varying complexity.
Demonstrate	Learners illustrate and explain how an identified computer system or process functions. This may take the form of an extended writing response, a diagram or a combination of the two.
Describe	Learners provide an account of something, or highlight a number of key features of a given topic. May also be used in relation to the stages of a process.
Develop	Learners provide a solution to a problem, typically using an existing system or structure that must be improved or refined.
Discuss	Learners investigate a problem or scenario showing reasoning or argument.
Draw	Learners represent understanding through the use of a diagram or flowchart.
Explain	Learners denote a series of linked points needed and/or justify or expand on an identified point required.
Evaluate	Learners review and synthesise information to provide a supported judgement about the topic or problem. Typically, a conclusion will be required.
Identify	Learners assess factual information, typically when making use of given stimuli. This requires a single word or short sentence answer.
Produce	Learners provide a solution that applies established constructs to a given computing problem.
State, name, give	Learners assess factual information. This requires a single word or short sentence answer.
Write	Learners produce a solution, or mechanism used as part of a solution to a given computing problem.

A few more guidelines

- Always make a plan for your answer before you start writing. Sketch this out so that you can refer to it throughout – remember to include an introduction and a conclusion and think about the key points you want to mention in your answer. On this plan, think about setting yourself some timeframes so that you make sure that you have time to cover everything you want to and, importantly, have time to write the conclusion!
- Try and keep your answer as focused on your key points as possible. If you find your answer drifting away from that main point, refer back to your plan.
- Make sure that you understand everything being asked of you in the activity instructions. It might help you to underline or highlight the key terms in the instructions so that you can be sure your answer is clear and focused on exactly what you have been asked to do.

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Sample answers

For some of the questions you will be given some background information on which the questions are based.

Look at the sample questions which follow and our tips on how to answer these well.

Worked example

Exam text

Sarah works as administrator of a small advertising company. Since starting her job she has been keeping a list of all the places where they have advertised and the responses generated from the adverts.

The owner of the business wants to know which adverts have been the most successful in terms of responses and whether the cost of each advert is viable.

Sarah has been keeping all the records and advertising costs on a spreadsheet but she thinks she needs to use a database program before the list becomes too big to manage. She has found someone who could produce an integrated system which will interact with all her administrative duties which include invoicing, credit control and producing reports for her boss. Her boss has agreed that Sarah meet with the developer to explain what the business requires and how the system would be used.

Answering extended answer questions:

1. Sarah wants to reorganise her administrative duties using an integrated system. Explain **two** implications for the business when designing an IT system.

For a question using the word 'implication' you must do more than just describe what needs doing. You will need to justify the reasons why they have to be done this way and what the advantages and disadvantages might be.

Exam sample answer

An IT system requires considerable planning to meet employer and user needs. Sarah will need to explain to the developer what the system will be used for and who will be using it so that the data are secure and that access is easy for her employer and other authorised users can operate the system should she leave the business.

Sarah will need to discuss with the developer the working practices of the business and what the impact might be when the new system is being implemented. Sarah's boss is concerned about lost data and whether there will be more expense while everyone is being trained.

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Sarah will need to check if the system will run automatic backups and the protocols that need to be followed to make sure that the accounts are safe. Sarah will also need to check how the system will verify and validate the data as it is input to ensure that it is accurate. Sarah currently verifies data manually by checking against the invoices for costs of adverts, but current methods for validating data have been time consuming and unreliable.

2. Sarah's boss has said he will need to provide monthly reports to his accountant on a routine basis. The problem is that the accountant will ask for different information depending on what he needs at the time. Some requests are VAT related while others might be relating to outstanding payments.

The accountant lives 300 miles away and sometimes travels abroad and has asked for reports to be sent by email to him so that he can check the records at any time.

a) Describe two options for enabling the accountant to access the information required.

b) Explain the advantages and disadvantages of each option and what Sarah could offer as a solution.

For a question asking you to explain advantages and disadvantages, you will need to demonstrate that you understand complex situations and can justify your reasons and provide recommendations for a solution that could be acceptable.

Exam sample answer

If the accountant contacted Sarah to produce reports whenever he needed them, this would provide the accountant with bespoke reports as required. However, the disadvantages include the impact on Sarah's workload and the time delay in getting the information back to the accountant, especially at times when Sarah is not at work. The main consideration is the risk to the security of the data if sent via email as either an attachment or in the email itself. The data could be at risk of hackers or be sent to the wrong person in error.

The accountant could also access the area of the local system containing the financial data needed via a VPN across the internet. Another alternative is that the system may also be stored in the cloud allowing collaborative access and ensuring that the data would be current and is backed up automatically using cloud storage.

The access would be password protected and, if the system has limited permissions, the data would be more secure by restricting the use by the accountant, so that the information required can be accessed but changes could not be made.

The advantages of the accountant having access to the system remotely include being able to obtain the information immediately when needed, anywhere and at any time of the day or night and not making Sarah responsible. This information might be required urgently by HMRC or to chase a long-standing debt.

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Disadvantages to using cloud computing and VPN are that if the accountant is working remotely in an area with unstable internet or limited bandwidth then the information might not be easily available. The accountant might not be able to respond to urgent and important requests due to downtime. The employer might also have to pay the accountant for the time spent trying to access the data although productivity is interrupted.

You might be asked to present your answer as a diagram to provide a thorough model of data sharing and connection types to respond to a scenario. In this case, you will need to ensure that your diagram is clearly annotated so that examiners can assess how well you understand and explain your answer.

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